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Increase in Electrical Exports

The returns of the Foreign Bureau of the Department of Commerce and Labor as to foreign trade in the month of October are once more encouraging from the statistical standpoint, but the various figures are so scattered that it still remains a most difficult if not impossible task to correlate and mass the electrical data as a unit. An agency so pervasive refuses to recognize, or eludes at every opportunity of escape, the stiff categorical summaries of a tariff drill sergeant. Anyhow, it soothes, satisfies and stimulates to note that during October, which was a desperately dull and doleful month for trade in general, electrical exports that cannot be classed possibly anywhere else and respond to every acid test showed a material advance over the outgo for the corresponding month for the preceding year. When we remember how much nicer and better the year 1912 was than 1913, it must be conceded that to gain at all in a general period of backsliding is, to use a choice classic phrase, "going some." It appears that the total export of electrical apparatus and supplies, in a list severely expurgated of most things that could swell it, was $2,516,583, as compared with $2,078,501 a year earlier. Such gains are not to be despised, but in these chastened days no one sits in the seat of the scornful. The ten-month totals show up equally well. In 1911 the figure was $15,596,575; in 1912 it was $18,755,966, and in 1913 it rose to $23,720,072. If some one in the department will only restore to us our lost provinces, we can exhibit a gain far better than that for even an off year.

New England Electrical Statistics

Interesting statistics of the central stations of New England are presented elsewhere in this issue. They show a decade of steady growth in one of the oldest sections of the country possessing water-powers transcending in importance all other natural advantages contributing to New England's industrial development. Census figures show that two-fifths of the total power derived from waterwheels by manufacturing establishments in the United States is found in New England and that one-fourth of the total power of all kinds used in New England factories is supplied by waterwheels. Fully 60 per cent of the minimum water-power available in her streams is now being utilized. It would appear therefore that her manufacturing industries are already supplied with cheap power, and this should be taken into consideration in any survey of central-station growth. Her cities are old and they have enjoyed the advantages of central-station service from the start. Therefore large increases cannot be expected. On the contrary, owing to consolidation of properties the tendency should be the other way, and this trend is shown clearly in the returns published in this issue. From an engineering viewpoint the data on steam and water-power growth reveal the influence of the steam turbine and also of the hydroelectric transmission plants. Strangely enough, New England, which has no coal and possesses plenty of water, shows a greater increase in steam than in hydraulic equipment during the last five years. Coal, despite its high price, still triumphs. Inasmuch as some knew and many surmised that the arc lamp in its present form would have to give way to the more efficient incandescent lamp, the government figures on that point should be conclusive. Most remarkable are the gains shown in the use of electric motors, which increased more than fivefold during the decade. The figures both in the aggregate and by states warrant much study.

Electric Parcel-Post Delivery

The success which has attended the use of electric trucks in post office operations in New York and other cities, and in the delivery service of express companies and department stores, is basis for urging the extensive use of battery-driven vehicles for parcel delivery in the newest branch of the government postal service. Ten-month comparative tests of gasoline and electric cars in parcel-post service recently conducted by the Indianapolis post office, as noted in these columns, showed a saving of one-fifth in operating costs in favor of the electric vehicles. This interesting official test under parcel post conditions only serves, of course, to confirm the knowledge, already familiar to those charged with the package-delivery problems of large private corporations, that for short-haul, frequent-stop service the electric wagon has no competitor. Its reliability in use and its durability in surviving the hardships of postal service is attested, too, by five years' experience with these cars in the transportation of the New York mails, while the friendly attitude of officialdom toward electric transportation is evidenced by the extensive application of "electrics" in other government departments. The Government Printing Office, the Bureau of Engraving and Printing, the Bureau of Buildings, the navy and the Bureau of Insular Affairs are, for example, all making successful use of large fleets of electric trucks. The last-named even has a number of these vehicles in the Philippines, where they are employed in the novel service of hauling water under the severe climatic conditions of those tropical islands. Concerning the

wider use of electric vehicles in parcel delivery it cannot be doubted that the post office officials charged with the heavy task of instituting a great country-wide system of parcel transportation are giving the most careful attention to the complex problems of terminal delivery, and it also goes without saying that, actuated by the spirit of "efficiency" which has been taken as the watchword of the present administration, they have watched with keen appreciation the records of economy and service being made by electric trucks in both government and private package-delivery duty. That the electric truck will on its merits win general recognition for parcel delivery its stanch adherents feel thoroughly confident; and in the central-station field the far-reaching significance of such an attainment as that foreshadowed should awaken the imagination and enlist the interest of the small-town manager as well as the big-city utility corporation, for, besides the incidental charging business assured from the postal vehicles themselves, general electric parcel-post delivery would in numerous communities prove to be the opening wedge of a healthy local electric-truck development.

Signaling to Moving Trains

From the very beginning of induction and other forms of space telegraphy inventors have proposed scheme after scheme intended to permit communication between fixed points and trains in motion. More than twenty-five years ago a magnetic induction system was successfully put into practice on one of the Eastern railways but was not found of especial practical value. The inception of radio-telegraphy gave impetus to those who were working on train telegraphy, since by its use the need of the long induction-wire paralleling the rails was obviated; and as late as 1907 patents were issued describing various ambitious arrangements of telegraph instruments, cab signals, automatic train stops, etc., controlled by "wireless." Invariably these depended for their operation upon filings coherers or other elements which would be equally unreliable under severe service conditions. These devices did not prove useful in the operation of railroads and never met continued or extended application. A few pseudo-wireless methods, such as that using a stream of conductive liquid projected from the locomotive to a wire or third-rail running along the tracks, have been brought forward, but each appears to have lacked some element essential to reliability. It has remained for one of our Eastern railroads to apply radio apparatus of recent design to the old problem, and within only the last few weeks results have been secured which indicate the desirability of extending the work to permit signaling to and from express passenger trains at all times throughout their runs.

On page 89 of the current issue Mr. John L. Hogan, Jr., describes the wireless telegraph plant and services of the Delaware, Lackawanna & Western Railroad. The results achieved speak for themselves, and it seems hardly necessary to comment upon the manifold uses to which the system should be applicable in the practice of railway operation. From the engineering viewpoint the data given are especially interesting, for apparently there is no reason why the general method might not be put to advantageous use elsewhere. It would seem, however, that there are involved a number of problems not yet so well settled as to permit efficient design of future plants intended for train communication. The form of antenna used on the cars would seem to function more as an electrostatic reservoir than as a radiator or absorber of ether waves, and the ease with which signals were received when the train was entirely underground suggests that in the transmission of messages earthed ether-waves are less concerned than are high-frequency current groups traveling by way of the earth and rails. The "swinging" of signal intensity which is so pronounced may be due to any or all of several causes, and definite investigation of these should result in a further knowledge of the mechanism of radio signaling by grounded waves. With the facilities for experiment which are now at hand it is hoped that a thorough series of tests will be made, and that study and correlation of the data obtained will do much to clear up some of the ever-mysterious phenomena involved in the transmission of radio-frequency electrical impulses.

Graphical Methods of Representing Color Values

In the *Elektrotechnische Zeitschrift* of Nov. 13, 1913, Dr. L. Bloch contributed an article suggesting an industrial method of defining numerically and representing graphically the color values of any particular illuminant, such as a tungsten-filament incandescent lamp at a specified power consumption. We abstracted the article in our Digest shortly after its appearance, and also commented upon it editorially. Briefly to recapitulate, the method involves the use of a photometer head, provided with three selected oculars, having tinted glass screens of red, blue and green, which could be used successively in the comparison of a test lamp against a standard lamp. A complete photometric measurement thus involves three such measures, or groups of measures, one with each color screen, or color filter, in front of the observer's eye. The measurements are similarly made on standard daylight against the same standard lamp. In this way red-green and blue-green ratios are determined both for the test lamp and the daylight. The two pairs of ratios are then divided, each by each, to produce final resulting ratios of red-green and blue-green, as between the best lamp and daylight. In the case of a lamp that might happen to have precisely the same color as the standard daylight, these final resulting ratios would be 1.00 for both red to green and blue to green.

In a more recent article published in the *Elektrotechnische Zeitschrift*, by Erich Jasse, the graphic presentation of the Bloch measurements is discussed with re-

lation to Maxwell's color triangle. Herr Jasse shows that the Bloch ratios, by a simple numerical treatment, can be assigned to definite positions within a Maxwellian equilateral color triangle. To recapitulate the facts briefly, standard white light occupies the middle point of such a triangle, with pure red, blue and green at the three respective corners. Reddish lights run toward the red corner, bluish lights toward the blue corner and greenish lights toward the green corner. Consequently, any point on the Bloch rectangle co-ordinate plan corresponds to a definite point inside the Maxwell equilateral plane triangle.

Maxwell's triangle has been used by several observers to designate lamp color values, and especially by Dr. H. E. Ives. Herr Jasse plots on a Maxwellian triangle not only fifty-three observations of Bloch on different kinds of industrial lamps, but also about a dozen similar observations by Ives. He shows that they differ in a definite manner—namely, that the Ives values lie more toward the green and less toward the blue. It is hard to define what standard cloudy daylight means, and the more carefully we try to define it the more cloudy our efforts are apt to become. Instead of our taking daylight as standard for the center of our color triangles, it will probably be advisable to make up a definite "artificial white" light in the laboratory and put that in the bull's-eye, letting the infinite varieties of daylight fall where they will. The quality of daylight is not strained.

The World's Longest Transmission Line

The second and concluding portion of our account of the Big Creek plant in this issue is devoted in the main to the line and substation equipment. The second generating plant so closely resembles the first that it may be passed over very briefly. The 150,000-volt transmission line, however, is notable in many of its features. In the first place, it is in complete duplicate, consisting of two steel-tower lines, erected 80 ft. apart, each carrying a single three-phase circuit, the wires of which are supported in a single horizontal plane, each by nine disk insulators in series. The towers used are of very moderate height, only 43 ft. to the cross-arm from which the suspension insulators are carried, and are placed also at moderate intervals, being on the average 660 ft. apart. The line wires are carried rather low, as little as 25 ft. in the center of the spans, a height which would seem precariously low in a more thickly settled country. The general nature of the structure, however, is such as to give unusual stability to the line, and as the circuits are on a private right-of-way 150 ft. wide, the lack of height may be justifiable. The spacing between wires is at the record figure, 17.5 ft., and wherever necessary the wires have a tension mooring to the structure through a string of nine insulator disks to check lateral swaying.

It is interesting to note how the fear of inductance due to wide spacing has disappeared as these long circuits have been instituted. In fact, added inductance is rather a good thing in view of the unavoidable capacity effects. The line wires themselves are of unusual size and character, being aluminum cable laid over a stranded steel core. The over-all diameter of the cables is 0.95 in. and the weight about 2 tons per mile. Each pole line carries on its top a galvanized-steel cable serving as a ground wire in accordance with general practice. The total length of this transmission line is 241 miles to the Los Angeles substation.

The substation equipment possesses some interesting features enforced by the very high voltage and the large amount of energy which must be dealt with. The high-voltage busbars in both the generating and the receiving stations, for instance, are of 2-in. wrought-iron pipe with all fittings carefully rounded off to decrease the chance of coronal discharge. The large diameter of the line conductors tends to lessen trouble from this particular source. The switching appliances for the operation of this system are somewhat formidable and seem rather intricate. Indeed, it is fairly safe to predict that so far as service conditions go the switchboard will require at least as much care as the rest of the generating plant. Energy is received from the generators at 6600 volts, passes to the third floor of the station to the oil switches, and then back to the second floor to the duplicate busbars, from which the transformer banks are operated. There are also two sets of 150,000-volt transfer busbars connected by remote-control oil switches, and still other switches are installed to connect either high-tension bus to either transmission line. Each of the main 150,000-volt oil switches occupies 1200 cu. ft. and weighs 14 tons. It would be rather interesting to know the cost of the switching apparatus and of the space required to contain it as compared with the cost of the generating units. The time seems almost to have arrived in high-tension work at which the generators and prime movers become a comparatively insignificant part of the show. This is, indeed, one of the interesting economic problems involved in the use of extreme voltage.

A striking feature of the main substation equipment is the installation of two 15,000-kva synchronous "condensers" to compensate for the capacity effects on the long lines. These machines will doubtless at times prove very convenient, but we have a suspicion that when the load is really taken aboard they will not be used to any large extent. Line capacity has been one of the terrors at all stages of the growth of electrical transmission, yet as experience has been acquired in the course of progress this lion in the way has usually shrunk to the dimensions of a domestic cat. It is only on lines considerably longer than anything yet attempted that the voltage rise due to capacity may be reasonably expected to reach a figure calling for extreme measures. However, since good regulation and continuity of service are of fundamental importance in all transmission work, one must look leniently on extraordinary precautions even though eventually they may prove needless.

The News of the Week

**Activities and Events in the Electrical Field—
Reports of Meetings—Commission Findings, Etc.**

National District Heating Association

The sixth annual convention of the National District Heating Association will be held at Rochester, N. Y., May 26, 27 and 28. Among the papers to be presented are the following: "Use of Bleeder Turbines in Connection with Steam Heating," by Mr. R. D. De Wolfe, Rochester, N. Y.; "Manufacture of Welded Iron and Steel Pipe," illustrated by moving pictures; "Hot-Water Heating Under Forced Circulation," by Mr. Thomas Donahue, Lafayette, Ind.; "Expense of Operating Centrifugal Pumps Versus Double-Acting Pumps," by Mr. A. C. Rogers, Toledo, Ohio; "Some Effects of Utility Regulation as Affecting District Heating," by Mr. D. L. Gaskill, Greenville, Ohio, and Mr. H. Almert, Chicago, Ill.; "Effects of Superheated Steam on Heating Systems," by Mr. Davis S. Boyden, Boston, Mass.; "District Heating for Small Towns and Cities of 10,000 Population and Under," by Mr. L. T. Mason, Hornell, N. Y.; "Heat Losses from Buildings of Latest Construction," by Mr. H. Byers Holbrook, New York; "Preferred Practice in Heating Buildings," by Mr. E. L. Wilder, Rochester, N. Y.; "Advantages of Central Station Heating Over Individual Plants," by Mr. N. M. Argabrite, Elwood, Ind.; "Customers' Steam-Heating Systems," by Mr. H. R. Wetherell, Peoria, Ill.; "Commercial Steam Heating in New York City," by Mr. George W. Martin, New York. President S. Morgan Bushnell, Chicago, is also scheduled for an address, and Mr. A. D. Spencer, Detroit, Mich., will report for the meter committee; Mr. A. P. Biggs, Detroit, Mich., for the record committee; Mr. D. S. Boyden, Boston, for the educational committee, and Mr. Byron T. Gifford, Grand Rapids, for the station operating committee. Mr. D. L. Gaskill, Greenville, Ohio, is secretary-treasurer of the National District Heating Association.

Meeting of Electrical Contractors of Missouri

The thirteenth semi-annual meeting of the electrical contractors of the State of Missouri was held in Kansas City, Mo., Dec. 20. An experience meeting at the Coates House was followed by a banquet during which matters pertaining to the contracting business were discussed. Mr. F. B. Uhrig, district manager of the Western Electric Company, spoke at some length on the objects and aims of the Society for Electrical Development; Messrs. B. S. Cowie, J. H. Ross, C. J. Sutter and W. L. Hutchinson spoke from the viewpoint of contractors, and Messrs. C. H. Talmage, P. B. Chaney and K. G. Rennie voiced the views of the jobbers. During the meeting a resolution protesting against the letting of the electrical work of the State Capitol of Missouri to a plumbing contractor who had included the electrical work in his bid for the plumbing and steam heating was passed. The Electrical Union in Kansas City and also the Electric Club of Kansas City were asked to second the action of the Contractors' Association, inasmuch as it was considered a bad precedent to have the electrical work done by any other than an electrical contractor. The meeting adjourned to convene on the Monday preceding the holding of the meeting of the National Electrical Contractors' Association in Detroit in July of this year.

Electric Starting and Lighting Practically Universal on Automobiles

The fourteenth annual National Automobile Show was held at the Grand Central Palace, New York, Jan. 3 to 10 inclusive. In all there were 352 exhibits, 255 of which were made by accessory manufacturers, eighteen by gasoline-car makers and six by electric-vehicle manufacturers. The total number of cars exhibited was 492, the lowest-priced being $395 and the highest-priced selling at $7,200. No commercial cars were shown.

In gasoline-car design several changes have been made which are of interest to the electrical fraternity. There appears to be a general tendency toward clearing the running boards and exterior of the cars of all apparatus, which has resulted in supporting storage batteries beneath the cars or in some place where they are inconspicuous. Electric horns have in many cases been mounted inside the hoods with their funnels opening near the radiator. Side lamps have been eliminated to a great extent by using lower-powered head lamps or employing the usual types with special dimming devices. The general tendency is to obtain a stream-line body, and where accessories interfere they have been made to conform with the lines of the car or have been placed elsewhere.

Electric gear shifts are being tried on a few cars. On one type of car the process of selecting the speed ratio is done mechanically, while the final operation of meshing the gears is by a solenoid magnet. Considerable attention has been given to the protection of starter, lighting and ignition wiring on some cars, all wires being inclosed in flexible conduit. Because of the low voltage popularly used for electric cranking the starters and switches are being mounted very close together, if not in a unit, to avoid excessive line drop.

Electric starters are now used on over 90 per cent of the American models, as against 47 per cent last year. About 62 per cent gear into the flywheel, 15 per cent connect with the front end of the engine shaft through gears and silent chains, and the remainder connect with the timer gear, etc. The reduction in the weight of starting devices has been considerable, being as great as 20 lb. in some cases. Electric lighting has become practically universal even on the inexpensive cars. About 89 per cent are electrically lighted in comparison with 50 per cent of last year.

From records compiled 1,127,940 automobiles were in use last year, an increase of 605,001 over the registration figures of 1911. New York still leads with a total of 133,000 registrations; Illinois is next with 95,000, and Ohio is third with 87,000. Pennsylvania, Iowa, Indiana, Massachusetts and New Jersey follow in the order named.

Output of Large Generating Systems

The accompanying table gives statistics on the output, peak load and load-factor of the generating stations of the Niagara Falls Power Company, Commonwealth Edison Company, New York Edison Company, Philadelphia Electric Company, Edison Electric Illuminating Company of Boston and the Edison Electric Illuminating Company of Brooklyn. Data on the same stations for the year 1912 were published in our issue of January 11, 1913. The Commonwealth Edison system still has the highest peak load and the largest output of the purely central-station systems, chiefly because of its great railway load. It is worthy of note that the yearly output of the Commonwealth Edison Company, which is given approximately, and that of the Niagara Falls Power Company are almost equal.

DATA ON LARGE GENERATING SYSTEMS

System	Peak Load in Kw.	Date of Peak Load	Yearly Output in Kw-hr	Yearly Load-Factor, per Cent
Niagara Falls Power Company	133,800	Dec. 8	949,886,570	81
Commonwealth Edison	271,000	Dec. 15	950,000,000	42–43
New York Edison	225,902	Dec. 23	685,947,000	34.7
Philadelphia Electric	76,133	Dec. 11	229,529,589	34.4
Boston Edison	63,131	Dec. 16	179,990,611	32.5
Brooklyn Edison	48,400	Dec. 23	139,737,007	33

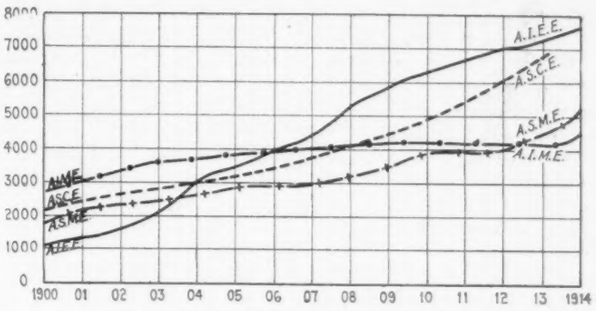
The figures of the latter cover the combined output of the Niagara Falls Power Company and the Canadian Niagara Power Company, which virtually compose a single system, the stations being operated in parallel. During the eleven months from January to November inclusive it was necessary for the Buffalo company to purchase energy elsewhere to meet its demand, but during the month of the December the entire Buffalo demand was taken care of by the Niagara Falls Power Company. The load-factors of the Edison companies in New York, Philadelphia, Boston and Brooklyn, it will be noted, did not vary greatly during the year, and in this connection the peak load, total output and load-factor of the Niagara Falls Power Company are of particular interest. All companies show substantial increases in output. The Commonwealth Edison, owing to large accessions of railroad load during the year and an increase of nearly 50 per cent in the commercial business contracted for, shows an increase in output of between 18 per cent and 19 per cent.

The Philadelphia Electric Company, owing to large railway loads secured, experienced the largest percentage gain in output during the year (approximately 25 per cent), while New York, Boston and Brooklyn show increases of about 11 per cent. The increase in output of the Niagara Falls Power Company is over 9 per cent.

Growth of the National Engineering Societies

From a position in 1900 least in point of membership among the four national engineering societies, the American Institute of Electrical Engineers has in fourteen years attained an enrolment of 7600 members, outstripping that of any of its older sister organizations. The accompanying curves show graphically the last fourteen years' growth of the Institute, the American Society of Civil Engineers, the American Society of Mechanical Engineers and the American Institute of Mining Engineers.

The relative positions of the mining and electrical engineers at top and bottom of the list respectively have been interchanged, it will be noted, although in 1900 the mining institute had more than twice the membership of the Institute of Electrical Engineers. It was in 1903 and 1904 that the latter enjoyed its most rapid growth, passing in 1906 the mining engineers, and since that time the electrical engineers' enrolment has always



GROWTH OF NATIONAL ENGINEERING SOCIETIES

been the largest among the four societies. The American Institute of Electrical Engineers now enjoys an income of $105,000 per year.

Electrical Energy Imported Into the United States

The reports, returns and statistics of the inland revenues of the Dominion of Canada for the year ended March 31, 1913, which were recently published by the government, contain some very interesting statistics on the electrical output of certain stations in Canada. A feature of the report is that part dealing with the export of electrical energy from Canada to the United States.

ELECTRICITY EXPORTED FROM CANADA TO THE UNITED STATES

Name of Company	Kw-hr. Generated	Kw-hr. Exported to United States	Kw-hr. Used in Canada
Ontario & Minnesota Power Company, Fort Frances, Ont.	22,328,033	21,233,520	1,094,513
Canadian Niagara Power Company, Niagara Falls, Ont.	336,762,830	325,775,842	10,986,988
Electrical Development Company, Niagara Falls, Ont.	210,807,408	55,034,200	155,773,208
Ontario Power Company, Niagara Falls, Ont.	539,237,558	254,286,580	284,950,978
Maine & New Brunswick Electric Power Company, Aroostook Falls, N. B.	2,434,516	2,371,446	63,070
British Columbia Electric Railway Co., Vancouver, B. C.	121,071,571	282,383	120,789,188
Western Canada Power Company, Vancouver, B. C.	21,461,255	3,259,693	18,191,562
Total	1,254,103,171	662,243,664	591,849,507

There were on March 31, 1913, seven companies exporting electrical energy, and three more were preparing to do so. In fact, the different hydroelectric enterprises operating near the border line sold in the aggregate more electrical energy to the United States than was sold for home consumption. The three companies which were prepared to export energy were the Cedar Rapids Power Company, of Soulanges, Quebec; the Electrical Distributing Company, of Windsor, Ontario, and the Sherbrooke Railway & Power Company, of Sherbrooke, Quebec. Data on the seven companies exporting electricity are given herewith. It will be noted that the bulk of the energy imported is brought across at the Niagara frontier line and used in New York, which absorbed more than the Province of Ontario.

Chicago Meeting of the Independent Telephone Association

The Independent Telephone Association of America opened its first convention in Chicago on Jan. 7 with about 200 in attendance. The association was formed in October, 1913, by representatives of independent companies. Mr. E. B. Fisher, Grand Rapids, Mich., in his presidential address urged competition in telephone service. Mr. C. B. Randall, St. Paul, Minn., outlined the qualifications fixed for members of the association. Any company may join if the American Telephone & Telegraph Company does not hold a substantial financial interest in its stock. Alderman Merriam, of Chicago, addressed the convention on the work of public service corporations. Addresses were made on the subjects of liability insurance and on accounting matters.

New England Central-Station Statistics

Preliminary figures of the forthcoming quinquennial report of the central stations of various states have been given out by the Bureau of the Census, Department of Commerce. The statistics relate to the years ended Dec. 31, 1912 and 1907, and June 30, 1902, and cover both commercial and municipal electric-light plants. They do not include electric plants operated by factories, hotels, etc., which utilize the energy generated, those operated by the federal government and state institutions, or plants that were idle or in course of construction. The data on central stations of the New England States are published herewith, and for convenience information for the entire New England States has been combined in Table I.

The figures as presented show that during the five-years 1907-1912 there were substantial gains in the industry. Although there was an increase of only three stations, the increase in gross income was $10,646,937 (57 per cent). The increase for the decade 1902-1912 was 174 per cent. Corresponding expenses show increases of 70 and 170 per cent respectively. The total horse-power installed indicates gains of 72 per cent during the five-year period and 160 per cent for the ten-year period. There was a decrease in the number of steam units, although a rather substantial increase in their aggregate rating. The decrease in the number of steam units is reported from Massachusetts and Rhode Island and would appear to indicate the influence of the steam turbine on steam-generating equipment, and also the effect of hydroelectric transmission companies. The rating of station generators increased 78 per cent during the five years and 217 per cent during the decade.

There were 879,272,535 kw-hr. of energy generated during the year 1912, an increase of 85 per cent over 1907 and of 225 per cent over 1902. It is evident that the arc lamp cannot meet the onslaught of the incandescent lamp, for there was a decline in its use of 20 per cent during the 1907-1912 period, the probability being that the greatest rate of decline occurred during the last few years. From the returns by states it will be noted that arc lamps held their own up to the census of 1907 and that at that time there were substantial increases in their number over the 1902 census.

Large gains are shown both in the number and aggregate rating of motors installed, not only during the decade, but during the 1907-1912 period. It is noteworthy that whereas arc lamps showed a decline of 20 per cent and other lamps an increase of 70 per cent during the five-year period, the horse-power rating of motors during the same period showed an increase of 153 per cent. The increase for the decade, 529 per cent, is even more startling, showing, as it does that the manufacturing establishments of New England appreciate the value of central-station service for industrial purposes. This large increase in the number of motors had its effect on the incomes of the company as shown in the income account, although some of the difference may be attributed to the general reduction in rates for electrical energy over the period. The first half of the decade showed an increase in gross income for light, heat and power of 72 per cent, whereas the last half of the decade showed an increase in gross earnings of 55 per cent.

According to the census of 1910, the population in New England was 6,552,745, apportioned as follows: Maine, 742,371; New Hampshire, 430,572; Vermont, 355,956; Massachusetts, 3,366,416; Rhode Island, 542,-674; Connecticut, 1,114,756. The gross earnings per capita for all of New England are, therefore, $4.50, which is a fair figure considering that all of the population is taken into account, and not just that portion of it within reach of central-station circuits. In a census of thirty-one stations operating in the State of

TABLE I—CENTRAL-STATION STATISTICS OF NEW ENGLAND STATES

	1912	1907	1902	Per Cent Increase 1907–1912	Per Cent Increase 1902–1912
Number of establishments	368	365	314	0.9	17.0
Commercial	311	314	279	—0.9	11.5
Municipal	57	51	35	12.0	63.0
Income	$29,307,441	$18,660,504	$10,697,077	57.0	174.0
Light, heat and power	$28,129,882	$18,123,382	$10,504,638	55.0	167.0
All other sources	$1,177,559	$537,122	$192,439	100.0	512.0
Total expenses, including salaries and wages	$21,414,431	$12,575,595	$7,953,633	70.0	179.0
Total number persons employed	7,352	5,088	3,673	44.0	100.0
Total horse-power	715,810	415,794	275,433	72.0	160.0
Steam and gas engines (including turbines):					
Number	610	634	623	—4.0	—2.0
Horse-power	526,743	281,550	183,496	87.0	187.0
Waterwheels:					
Number	511	462	295	11.0	70.0
Horse-power	208,501	130,731	62,171	60.0	235.0
Kw rating of generators	514,889	289,388	162,789	78.0	217.0
Output of stations, kw-hr	879,272,535	473,802,067	247,727,501	85.0	255.0
Estimated number of lamps wired for service:					
Arc	44,682	56,041	47,017	—20.0	—5.0
All other varieties	7,957,913	4,678,690	2,425,235	70.0	228.0
Stationary motors served:					
Number	55,042	23,841	12,736	130.0	332.0
Horse-power	391,308	154,720	62,163	153.0	529.0

Iowa, published in the *Electrical World*, May 17, 1913, it was shown that the gross income per capita for that number of stations was $5.74 in 1912; the gross earnings of twenty-six stations in the same state in 1910 was $4.36, and for 1908 $3.93 per capita. In the above Iowa censuses only that portion of the population served was taken into consideration.

Considering the showing made by the various states during the decade as given in Table II, Maine showed a decrease of 17.3 per cent in the number of arc lamps wired for service and an increase of 135.4 per cent in all other varieties of lamps. In the case of the aggregate income of seventy-nine establishments there was an increase of 195.3 per cent. There were also gains in total horse-power reported of 260.3 per cent and in the rating of generators of 284.3 per cent. The output of stations increased 432.5 per cent and the horse-power rating of motors 405.4 per cent.

In New Hampshire the fifty-nine establishments showed a gain in gross earnings of 180 per cent. Station outputs increased 362 per cent and the number of motors served 371. Arc lamps fell off 34 per cent.

Vermont showed a decrease in the number of arc lamps of 29.6 per cent with an increase in other lamps

of 150.9 per cent. The gross earnings of the operating companies showed an increase of 141.8 per cent, and the horse-power of motors an increase of 750.2 per cent.

Massachusetts companies experienced a gain in income of 154.1 per cent, with a gain in corresponding expenses of 147.4 per cent. The rating of waterwheels increased 174 per cent and the rating of steam-gas engines 183.6 per cent, although there was a decrease in the number of such engines of 19.8 per cent. Stationary motors showed a gain of 540.2 per cent in rating. The decrease in the number of arc lamps during the decade was 1.9 per cent, while the increase in other varieties of lamps was 229 per cent over the arc.

The gain in gross earnings of the companies in Rhode Island during the decade was 125 per cent. There was a marked decrease in the number of steam and gas engines and also in the number of arc lamps in service, a loss of 17.9 per cent in the case of the former and of 14.4 per cent in the case of the latter. The increase in horse-power rating of steam and gas engines was 207 per cent, and stationary motors showed an increase of 352 per cent in rating.

Connecticut showed a substantial gain in the income of operating companies of 305 per cent; the rating of generators increased over 400 per cent and the output 388 per cent. There was an increase in the number of lamps other than arc lamps of 395 per cent, and the horse-power rating of motors installed during the decade showed a remarkable increase of 834 per cent.

One would expect that the great manufacturing states of Massachusetts, Rhode Island and Connecticut would show greater incomes per capita than the others. However, New Hampshire shows the greatest income per capita of the New England States, the income exceeding that of Massachusetts and Connecticut (which have approximately the same income per capita) by 12½ per cent. Rhode Island is the fourth state on the basis of income per capita, Vermont the fifth, and Maine the last. The income per capita of New Hampshire exceeded that of Maine by nearly 100 per cent.

TABLE II—CENSUS RETURNS OF NEW ENGLAND BY INDIVIDUAL STATES

	MAINE			NEW HAMPSHIRE			VERMONT		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	79	81	52	59	56	51	61	60	52
Commercial	75	77	50	56	52	50	48	47	41
Municipal	4	4	2	3	4	1	13	13	11
Income	$2,044,280	$1,453,016	$692,350	$2,326,998	$1,422,345	$832,322	$1,173,851	$841,701	$485,505
Light, heat and power	$1,740,858	$1,324,648	$668,575	$2,199,468	$1,321,296	$826,176	$1,128,287	$795,391	$461,898
All other sources	$303,422	$128,368	$23,775	$127,530	$101,049	$6,146	$45,564	$46,310	$23,607
Total expenses, including salaries and wages	$1,577,938	$1,181,255	$571,089	$1,596,152	$912,214	$554,967	$824,443	$682,003	$333,853
Total number of persons employed	629	502	340	578	422	294	340	297	242
Total horse-power	89,683	57,880	24,889	84,228	46,784	28,096	50,363	38,566	23,857
Steam and gas engines (including turbines):									
Number	61	75	57	67	52	44	42	39	37
Horse-power	19,745	17,043	11,080	27,291	20,375	12,690	15,091	9,969	7,561
Waterwheels:									
Number	175	132	54	115	101	78	99	101	80
Horse-power	69,938	39,766	13,046	56,937	25,404	15,406	35,272	28,472	16,296
Kilowatt rating of dynamos	58,757	39,290	15,291	57,768	31,917	17,777	29,468	21,854	11,442
Output of stations, kilowatt-hours	117,092,565	66,136,651	21,987,700	126,593,970	55,258,921	27,377,793	56,552,977	29,923,333	22,374,060
Estimated number of lamps wired for service:									
Arc	1,863	3,187	2,254	1,900	3,510	2,879	1,080	1,866	1,534
All other varieties	481,748	443,192	204,632	397,491	301,734	170,541	404,151	306,245	161,106
Stationary motors served:									
Number	2,258	1,304	525	1,958	1,061	415	1,966	776	273
Horse-power	32,535	19,372	6,437	18,488	10,231	4,583	23,695	9,778	2,787

TABLE II (CONTINUED)

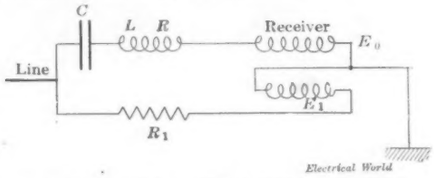
	MASSACHUSETTS			RHODE ISLAND			CONNECTICUT		
	1912	1907	1902	1912	1907	1902	1912	1907	1902
Number of establishments	117	120	114	8	7	7	44	41	38
Commercial	87	96	97	7	6	6	38	36	35
Municipal	30	24	17	1	1	1	6	5	3
Income	$16,111,496	$10,749,240	$6,340,944	$2,305,176	$1,724,659	$1,026,407	$5,345,640	$2,469,543	$1,319,549
Light, heat and power	$15,801,050	$10,602,498	$6,244,882	$2,204,999	$1,627,190	$985,595	$5,055,220	$2,452,359	$1,317,512
All other sources	$310,446	$146,742	$96,062	$100,177	$97,469	$40,812	$290,420	$17,184	$2,037
Total expenses, including salaries and wages	$11,651,739	$7,065,197	$4,708,732	$1,654,848	$1,052,695	$803,161	$4,109,311	$1,682,231	$981,831
Total number of persons employed	3,954	2,672	2,024	511	450	274	1,340	745	499
Total horse-power	350,780	188,335	124,213	50,499	27,986	17,600	90,257	56,243	28,389
Steam and gas engines (including turbines):									
Number	292	319	364	23	32	28	125	117	93
Horse-power	326,300	170,714	115,069	48,059	25,500	15,650	90,257	37,949	21,446
Waterwheels:									
Number	58	58	41	13	16	11	51	54	31
Horse-power	24,480	16,781	8,933	2,440	2,263	1,925	19,434	18,045	6,565
Kilowatt rating of dynamos	252,732	135,924	90,624	38,509	21,040	12,139	77,655	39,363	15,516
Output of stations, kilowatt-hours	386,254,294	219,425,607	125,813,392	62,106,528	35,651,323	23,436,435	130,672,201	67,406,232	26,738,121
Estimated number of lamps wired for service:									
Arc	28,238	33,869	28,790	4,419	5,970	5,161	7,182	7,639	6,399
All other varieties	4,687,246	2,655,303	1,420,963	640,769	385,329	196,188	1,346,508	586,887	271,805
Stationary motors served:									
Number	37,191	15,877	9,663	3,690	2,082	989	7,979	2,741	871
Horse-power	228,868	81,246	35,749	28,186	12,947	6,236	59,536	21,146	6,371

Avoiding Telephone and Telegraph Disturbances from Single-Phase Lines

Mr. G. Girousse, engineer of telegraphs, France, discussed in the Dec. 6, 1913, issue of *La Lumière Electrique* several methods that are available for minimizing the disturbance produced by single-phase distribution systems upon telephone and ground-return telegraph circuits. Four remedies are available, namely, the use of compensating devices, the shifting of such circuits to pole lines at least 1 mile distant from the high-tension route placing them underground and doubling them by adding return wires. All remedies but the first are rejected by M. Girousse as too costly. He states that for telegraph lines very satisfactory results have been obtained with the following inexpensive schemes as first tried in the latter part of 1911 on the 6000-volt, twenty-five-cycle Maritime Alps, the 10,000-volt, twenty-five-cycle Haute Vienne and the 12,000-volt, twenty-five-cycle Oriental Pyrénées single-phase systems. Since then complete installations have been made for the first two lines named, and the equipments for the Oriental, Haute and Basse Pyrénées lines will soon be in place.

Protection of Telegraph Circuits

As shown in the accompanying wiring diagram, use is made of a receiver wound with two coils having the same number of turns and connected differentially. One of the coils is in series with a condenser C and a self-inductance L; the other is in series with a resistance R_1. As the telegraphic current is continuous, it does not traverse the former coil, and consequently the receiver acts in the normal fashion.



CIRCUITS OF DOUBLE-COIL RECEIVER

If the two circuits present the same resistance and the same reactance, the disturbing alternating current will divide in two parts alike in amount and phase, and consequently the receiver will not be disturbed. It is clear that these conditions are satisfied theoretically when there is resonance between the capacity C and the self-inductance L for the frequency of the disturbing current, and that R, the resistance of the self-inductance coil, is equal to the resistance R_1. When the conditions are carefully determined in advance, an arrangement of this kind will give good results without readjustment from time to time.

Protection of Telephone Circuits

Telephone circuits require both good insulation and minimum inductance. The insulators should be of the industrial type with large petticoats instead of the present French type with two bells. The petticoat insulators are much easier to maintain, particularly in cleaning, and they cost little more. The insulating points on telephone circuits which leave most to be desired are the underground sections which until lately have been freely installed at crossings with heavy current transmission lines. These underground sections, especially at the junctions with aerial lines, constitute the weakest points of a telephone circuit and should be avoided wherever possible.

It is also necessary to take certain precautions at the telegraph offices, for it is useless to insulate the line carefully if the office equipment suffers ground losses. To remove the interurban circuits from the bad influences due to losses either on the lines or the inside equipments, it is best to isolate the circuits by means of transformers. Excellent transformers which insulate against high-tension current are now available.

On some of the existing installations the interference with lines within the influence of induction from single-phase track circuits has been caused frequently by carbon lightning arresters. The extreme sensitiveness of these arresters is usually a valuable quality, but when their nearness to single-phase circuits causes excessive operation, the particles of carbon become detached. Disintegration causes leakage to ground which cannot be neglected. Therefore, it is desirable to replace such apparatus by arresters of either the horn or the vacuum type. This change will prevent the destruction of the arresters, but it is still necessary to provide means for avoiding shocks. If transformers were used, they would protect the office force but they would not protect the workmen on the line. In order to eliminate all dangerous high tensions, grounding discharge coils should be installed. These coils should be of the Cailho type which are used for telegraphing on telephonic circuits. As ordinarily made, this coil is not intended to take care of the high-voltage currents induced by single-phase circuits. A modification for the latter purpose, known as the Perego coil, has given good results on the circuits of the Oriental Pyrénées lines.

M. Girousse stated that the single-phase lines as usually installed to date offer grave difficulties to telephone and telegraph circuits. It is desirable that these troubles be made negligible. While it is difficult to make the above changes on existing lines, the methods described do permit the satisfactory operation of telephone and telegraph circuits at a very small additional expense.

Parcel-Post Delivery with Electric Trucks in New York City

Twelve of the electric trucks in the service of the New York post office are now engaged exclusively in delivering to addressees large and heavy packages sent through the parcels post. Accompanied by their drivers these vehicles are leased to the post office on the basis of a working day of eight hours out of a given ten, after which an extra charge is made for overtime. Each wagon when in service is in charge of a post office carrier who directs the driver where to go and himself attends to making the actual deliveries. The electric truck thus becomes in effect a huge portable "mail-bag" for the carrier assigned to the route. Only the heavier and bulkier parcels, of course, are thus delivered by truck, all lighter packages being handled by deliverymen on foot where feasible. In addition to these electric trucks, a number of horse-drawn wagons and several gasoline trucks are also in use for parcel delivery in the metropolitan district.

The twelve electric trucks referred to (some of which are illustrated in the accompanying halftones) make deliveries from nineteen postal substations. Service was begun in January of last year coincident with the inauguration of the parcels post, seven vehicles being used during the first months. Later this number was increased to fifteen, but with the cessation of service in the Bronx and Westchester County, three of the wagons were transferred to other duties, leaving the present "even dozen" in parcel-post service. These trucks are of General Vehicle Company manufacture and are all 1000-lb. wagons, with the exception of a 1-ton truck used to convey bulky matter from the Madison Square postal substation. The type of light wagon found

preferable for parcels-post delivery duty is seen to advantage in the foreground of Fig. 1, which shows a number of these electric delivery cars standing in front of the Lawrence Street garage of the Motor Delivery Company, which furnishes the trucks and drivers to the post office.

During the month of December, 1913, the twelve electric trucks of the company were in service twenty-seven days, traveling altogether 7111 miles and delivering 98,243 parcels. At this rate the parcel-post truck fleet covered an average distance of 263 miles per day, or 22 miles per individual vehicle. Deliveries were made at the rate of 3628 parcels per day, or about 303 per day per vehicle. The average distance traveled per package delivered was 0.0724 mile, or 382 ft. At the rental paid by the government for this delivery service the average cost per parcel was 3.3 cents, not including, however, the salary of the carrier who accompanied the truck on its rounds and made the actual deliveries to addressees. Generally similar values were obtained for the same service during November.

FIG. 1—ELECTRIC TRUCKS FOR PARCEL-POST DELIVERY, NEW YORK CITY

In addition to the electric wagons herein referred to, which as noted are employed exclusively for parcel-post delivery, a number of larger electric trucks are used for mail haulage between the New York City depots and postal stations. Some of these cars have been in service five or six years, having been used twenty-four hours a day and every day in the year during much of this period. Such mail service, according to those familiar with its requirements, is one of the most exacting to which commercial trucks can be applied, but has been negotiated with flying honors by the "electrics."

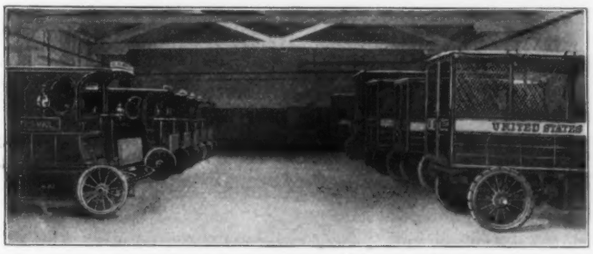


FIG. 2—INTERIOR OF LAWRENCE STREET GARAGE

The parcel-post wagons above described are leased to the post office by the Motor Delivery Company, New York, of which Mr. C. H. Bardwell is president.

Coolidge Patent on Ductile Tungsten

On Dec. 30, 1913, there was issued to Dr. William D. Coolidge, Schenectady, N. Y., a patent on "Tungsten and Method of Making the Same for Use as Filaments of Incandescent Electric Lamps and for Other Purposes." The serial application in this case, filed June 19, 1912, was in part an extension of four prior applications, the earliest under date of July 2, 1906. The invention covered by this patent is the now well-known ductile tungsten for incandescent-lamp filaments and other uses, which was discovered in the research laboratory of the General Electric Company. The following description of the process and the properties of the resulting material is drawn from the patent specification:

The tungsten of the prior art was obtained in the form of a steel-gray to black powder, having a fusing point at about 3200 deg. C. The metal itself, as produced in lamp filaments manufactured by the extrusion or "squirted" process, was invariably brittle and refractory and unsusceptible of being wrought or drawn into wire. The new process of making wrought or ductile tungsten is divisible into two stages, the preparation of an ingot or billet of tungsten and the working or fabrication of the ingot to desired shape. Commercially pure tungstic oxide (WO_3) is first dissolved in ammonia water, forming ammonium tungstate, then purified by crystallization over a steam bath, washed with distilled water, dried, and next decomposed by moderate heat—400 deg. to 500 deg. C.—which drives off the ammonia and leaves purified tungstic oxide. This is heated in a gas furnace for about five hours, in a covered Hessian or Battersea crucible, after which it becomes coarser and of higher density and contains new matter which is probably volatilized from the crucible, consisting largely of alumina and silica. The effect of these substances is found to be most beneficial when present to the extent of from 0.8 to 1.5 per cent. The material is then ground, and the firing operation repeated, if necessary, with a new crucible each time.

The next operation is performed in a tube of porcelain or fused quartz, having a diameter of 1.5 in. and a length of 24 in. This tube is packed nearly full of tungstic oxide except for spaces at each end and is gradually raised in a period of six or seven hours to a temperature of from 900 deg. to 1150 deg. C. Crystallinity in the metal powder is avoided by the slow raising of the temperature. Pure dry hydrogen is passed through the tube meantime for a period of from, say, six to fifteen hours. In this operation the tungstic oxide, or so-called "yellow oxide," is progressively reduced to the blue oxide, then to the brown oxide and then to the pure metal.

This powdered tungsten is next compressed in hydraulic presses, of great strength and rigidity, into sticks which, for example, may be ¼ in. square and 6 in. long. When removed from the mold the stick is slid gently onto a strip of molybdenum or tungsten and placed in an electric furnace of porcelain or alundum, and fired in a hydrogen atmosphere at, say, 1200 deg. C. for a period of from ten minutes to one hour, or long enough to make the stick sufficiently strong to permit handling readily. Next the stick is sintered in a closed vessel ordinarily of copper, containing a hydrogen or other reducing atmosphere; an electric current is passed through the stick to bring it to a blinding white heat (about 2800 deg. C.). In the case of the ¼-in. rod the preferred method is to sinter with an alternating current of from 1700 amp to 1800 amp for fifteen minutes. The stick is thereby sintered into a slug of coherent metal.

The next step is the hot mechanical working, first in

a special swaging machine. The billet is preheated to a temperature of from 1300 deg. to 1700 deg. C before its introduction between the swaging dies, through which it is passed very rapidly, with only a slight reduction in each pass. This operation is repeated numerous times, and after five passes the ¼-in. billet has become a circular rod 0.210 in. in diameter. There are ten steps in reducing this to a diameter of 0.060 in., the method of hot-working before mentioned being followed throughout. In six or seven more passes the diameter becomes reduced to 0.030 in. The temperature of the rod, which was at white heat in the early stages, is reduced to a yellow-red heat at a diameter of about 0.040 in. When a diameter of 0.030 in. has been attained the metal is ductile at room temperature.

Further reductions are accomplished by hot-drawing, with diamand dies heated to from 600 deg. to 650 deg.C., and the wire at a red heat. The diameter is reduced in this way, by 1-mil drafts, to 0.014 in.; then, by 0.5-mil drafts, to 0.0055 in.; next, by 0.25-mil drafts, to 0.004 in.; then by 0.2-mil drafts to 0.002 in., by 0.1-mil drafts to 0.0014 in., and finally by 0.05-mil drafts to a diameter of only 0.0005 in., or 0.5 mil.

The inventor states that the form of tungsten which he has produced is a new product differing radically from any form of tungsten heretofore obtained Not only is it pliable and ductile at room temperature, but it is strong and tough. It is said to be substantially non-oxidizing in moist air at ordinary temperatures and resists the action of acids to an unusual degree. Its specific gravity is higher than that of sintered tungsten and in certain samples has run to from 19.15 to 19.3. The tensile strength is exceedingly high, being found in certain samples of 0.001-in. diameter wire as high as from 600,000 lo. to 650,000 lb. per sq. in. It is non-magnetic, not easily corroded, and is elastic and resilient.

Methods of working the metal by hammering, forging and rolling are also described. The inventor states that the heat treatment is one of the particular features of his invention, too high a temperature at the outset, or much over 1500 deg. C., tending to prevent the change from crystalline to fibrous structure under mechanical working, and set up a reverse change. Later the temperature may be reduced to some 1200 deg. C. or lower, as the mechanical working progresses and the desired properties commence to appear. The somewhat elaborate preparation of the metal for the swaging process, the inventor states, is necessary in order to bring it into a favorable molecular condition for the ensuing treatment and working.

The use of the Battersea crucible, as before described, is claimed to render the metal when fabricated into lamp filaments immune to the tendency to "offset," or crystallize along a transverse section and develop a shear or offset at this weak point. Unless so treated, the metal when used at high temperatures tends to revert to the crystalline form.

The patent contains thirty-four claims, among which the following are suggestive and typical:

"1. The process of producing tungsten having a fibrous structure which consists in repeatedly hot-working a crystalline body of tungsten until the crystalline structure is broken down and a fibrous structure developed.

"2. The process which consists in agglomerating tungsten powder, sintering the body thus formed, subjecting it to repeated hot-working, and continuing such hot-working until the body remains ductile when cold.

"8. The method of producing pliable tungsten wire for lamp filaments, which consists in first producing a body of tungsten in a sintered state and free from oxygen carbon and other impurities which would render the body unworkable mechanically and then subjecting this sintered and purified body to mechanical working many times repeated, with gradual reduction in diameter and elongation in length.

"12. The process which consists in reducing tungsten oxide to coarse tungsten powder, agglomerating said powder into a coherent porous body, heating said body to drive out impurities and sinter the body, and then subjecting the body to hot mechanical working.

"14. The process which consists in forming a body of tungsten powder containing additional material which will prevent coarse crystallization of the tungsten at high temperature, sintering the body and then subjecting it to hot mechanical working.

"22. The method of securing a ductile metal body without previous melting of the metal, which consists in producing a compact body of metal from divided metalliferous material, consolidating said body by heating to a temperature less than the melting temperature and such as to produce a body of metal non-ductile when cold, subjecting the body to repeated mechanical working while in a heated condition, and continuing the working until the body is ductile without the application of heat.

"26. Substantially pure tungsten having ductility and high tensile strength.

"29. An incandescent electric lamp having a filament formed of ductile tungsten.

"34. Wrought tungsten, a solid coherent material characterized by the presence of crystals deformed by mechanical working."

One of the interesting features of this patent is its history in the Patent Office. The primary examiner rejected the entire application on the ground of prior disclosures in British patents No. 21,513 of 1906, No. 3174 of 1907, No. 16,530 of 1907 and No. 24,179 of 1906. The examiner also held that certain claims should be divided, under another application, and that some of the other claims were duplicates in patentable effect. In a decision of the board of examiners-in-chief, filed on Nov. 15, 1913, the citation of the first three British patents named above was rejected on account of their having been filed subsequent to July 2, 1906, the earliest filing date in the Coolidge application. The members of the board also dismissed the other contentions of the primary examiner except as to duplication of claims, and the latter ruling was over-ruled by the examiner-in-chief, so that the original application was finally allowed intact.

Discussion of Nitrogen-Filled Lamps at Boston

At the December meeting of the New England Section of the Illuminating Engineering Society Mr. L. A. Hawkins, engineer of the research laboratory of the General Electric Company, gave a lecture on the nitrogen-filled lamp and its possibilities. After reviewing in considerable detail the investigations leading to the production of the so-called "half-watt" lamp, the speaker discussed the study of evaporation problems in relation to filament life and diameter, automatic compensation of the filament for local variations in temperature, usefulness of spiral filaments, heat losses and bulb deposits. He also exhibited the latest forms of lamps, including the high-current lamp requiring 0.40 watt to 0.45 watt per mean hemispherical candle-power and smaller units adapted to stereopticon and head-lamp work.

It was pointed out that in using series lamps on lines subject to current fluctuations a compensator designed with a saturated core is desirable. The compensator provides a reactance which shunts the lamp in case it burns out. A 6.6-amp lamp is now being developed giv-

ing 1000 mean hemispherical candle-power with a power input of 750 watts. In the larger sizes the lamp casings are ventilated and diffusing globes are desirable. A 350-watt, 450-cp lamp is being developed for projector work. Other gases are being tested for the bulb filling, notably argon, which has a lower heat conductivity than nitrogen and a slightly less rate of evaporation. No radical change in lamp design is likely to follow the use of argon or mercury vapor.

Mr. Hawkins said that while the nitrogen-filled lamp joins issue with the arc lamp, the latter is probably much further from its ultimate possibilities than the nitrogen lamp. A specific consumption of 0.2 watt per cp is close to the melting point of the tungsten filament, whereas such limitation does not exist in the efficiency development of the arc lamp. No fear exists in well-informed circles that the arc lamp will be driven from the field. Both types will contribute to better service and longer life of illuminants. The time has passed when any fear need be felt by the development of any new and useful electrical appliance.

Discussion

Dr. Louis Bell, Boston, said that the absence of relation between the diameter of the filament and the loss of heat from it is the fundamental point in the nitrogen lamp's success. In the older days an inert gas was used to stop oxidation in lamp bulbs instead of to prevent evaporation. He said that in Europe last summer he had seen lamps ranging from 500 up to 5000 cp in size and pointed out the increased life tending to result from the use of lamps with long chambers and spherical bulbs. A life of from 800 hours to 1000 hours is reported on lamps of 600 cp to 1000 cp designed for multiple operation on small currents. Dr. Bell pointed out that his own tests had shown specific consumptions of 0.65 watt to 0.75 watt per cp in bare lamps designed for multiple service. In the globes a loss of 15 to 20 per cent more occurs, so that the initial consumption of the lighting unit is apt to be not far from 0.75 watt per candle in present designs of lamps. This may possibly be increased by the use of argon. As the efficiency of the modern arc lamp begins about where the nitrogen-filled lamp leaves off, the effect of the latter on the former is bound to be problematical. The speaker stated that he had recently seen an arc lamp in Paris with a consumption of 0.175 watt per mean lower hemispherical candle-power and had verified this figure by careful inquiry and examination of the original tests. The nitrogen-filled lamp is an efficient and powerful unit particularly adapted to alternating-current suburban districts, but there is no doubt that the modern arc lamp and its developments will still be used under favorable conditions in much of the practice of the future.

Mr. Alexander Macomber, Tenney Companies, Boston, spoke of the extensive development in glassware and shades likely to result from the intense brilliancy of the filament in the nitrogen lamp. Chairman C. A. B. Halvorson, Jr., Lynn, Mass., touched upon the possibilities of the nitrogen lamp in indirect lighting. Mr. George H. Stickney, General Electric Company, urged doing everything possible to improve the illumination furnished by existing equipment, absorbing more light in devices which make the light pleasant. Improved diffusion is demanded all along the line. The nitrogen lamp's freedom from adjustment is a valuable point. Used in head-lamp service on railroads where the laws are restrictive, for automobile service, for small moving-picture machines and in projectors for homes and schools, the nitrogen lamp is bound to give a good account of itself. Semi-indirect and indirect lighting is coming with these lamps.

Closing the discussion, Mr. Hawkins said that the efficiency of the compensator is about 95 per cent at 60 cycles, if designed only as a voltage transformer, its power-factor being from 98 to 99 per cent. To get shunt protection and to reduce the current fluctuations on the line, the efficiency is reduced to 90 per cent and the power-factor to about 90 per cent. The compensator lowers the specific consumption about 0.06 watt per candle-power. The 750-watt, 110-volt, 6.6-amp lamp has a life of about 900 hours at a specific consumption of 0.7 watt per cp, whereas the 20-amp lamp, at 0.5 watt consumption, gives a life of about 1800 hours. For prolonged rises in voltage these lamps are more sensitive than vacuum lamps, as the filaments are run closer to the melting point. So far as sudden surges of one second or less go, the nitrogen lamps, especially of the high-current type, stands the variation better than the vacuum lamp. The only effect of temperature is that if the lamps get too hot they blacken on account of an increase in the amount of water vapor given off. One of these nitrogen lamps will run at a temperature of nearly 200 deg. C. near the top of the lamp, so that proper ventilation is most essential.

The nitrogen lamp has no effect on house lighting, but opens a new field for incandescent-lamp service. Its probable life depends on the size of the filament and the efficiency. On high-current lamps a commercial life well above 1000 hours can safely be predicted. For lower current lamps a small change in efficiency affects the life to a large extent. The lowest current thus far used is in applications for projector work, where 3-amp size or lower are employed. The life is correspondingly shortened to about 200 hours, but this is not important in this particular class of service. For general illumination at least 5 amp must be employed. The nitrogen lamp has a candle-power depreciation due to evaporation. This has been tested to be 80 per cent of the initial lumens after 2000 hours' service. Much can be done in designing, however, to change this one way or the other. Under ordinary vibration the filament stands up well, and its softness and ductility when hot are favorable to long life.

Standardization of Public Utilities Service

On page 30 of our issue dated Jan. 3, 1914, was printed a part of a paper read by Dr. Edward B. Rosa, chief physicist United States Bureau of Standards, before the American Association for the Advancement of Science at Atlanta, Ga., on Dec. 31. The rest of the paper, explaining in further detail the ideas of Dr. Rosa on the "Standardization of Public Utilities Service," follows:

Monopoly and Regulation

Public utilities are no longer regarded as private business corporations, entitled to charge all the traffic will bear and to make all the money they can. On the contrary, they are now regarded as of a public character, enjoying a monopoly of the market but owing a duty to the public and entitled only to a reasonable return on their investments. Their duty to the public consists in rendering safe and adequate service at just and equitable rates. In return the utility is entitled to protection of its investment and to such dividends that the stockholders will have no just cause for complaint and that money may be had whenever necessary for extensions and improvements. Under this system, if a city wishes to own a given utility or all of its utilities, it may not build anew and disregard the property rights of existing utility companies, but should purchase such properties at fair valuations. Neither should a city grant a franchise to a second company which proposes

to compete with the first, even though it were offered a valuable consideration for such franchise. The justification for all this, of course, is that one company with all the business of a given utility can usually render better service than two or more could do with the business divided between them.

Thus it appears that the utility company is guaranteed a monopoly of the business, protection of its capital and a fair rate of return thereon. It in turn is expected to render the best service possible for the charges made; if a more expensive service is required than the company can afford to give, the public must pay higher rates. To secure good service and good management, competent managers and superintendents and operators must be employed, and the rates paid by the customers of the utilities (whether it be for gas or electricity or water, or for telephone or street-car service) must be high enough to permit good salaries and good wages to be paid. In short, the public pays all the expenses of operating the utilities, including salaries of officers, wages of employees, cost of expert engineers, dividends on capital, taxes, waste due to inefficient management if there be such, graft or commissions on purchases if any, and the expenses of the public service commission which regulates the utilities, and it gets in return such service as the utilities render at rates from which there is no appeal except to a public service commission where there are such commissions. In more than half of the states of the Union commissions are now established.

It is therefore no wonder that under these circumstances there is an urgent public demand for competent and adequate regulation of public utilities by public service commissions, such regulation comprehending not only the adoption of rules specifying the service that shall be rendered and fixing or approving the rates that shall be charged, but including also effective inspection to see that the service corresponds with the requirements and that the management is competent and efficient.

It may appear to some that a public service commission is going beyond its proper sphere when it inquires into questions of efficiency of management and honesty of administration. But if it be conceded that the stockholders are to receive a fair return on their investment, and the public is to get no better service than the company can give consistently with such dividends, it is readily seen that any loss due to inefficiency of process or apparatus or to incompetent or dishonest management comes mainly, if not entirely, out of the public rather than from the officers or stockholders. Hence the supervision and control by the public service commissions must be detailed and far-reaching if the public is to realize the full measure of protection which the system is designed to afford.

Such regulation corresponds with the view that "the fundamental relationship existing between the public and its public utilities is that of principal and agent." Of course, it is not expected that such regulation can be realized everywhere at once. It will require years to develop the new system to a state approximating completeness and perfection. In the meantime all degrees of regulation may be expected, down to the merest beginnings in which rules are adopted and reports received but inspections are scant and rates are scarcely considered.

Quantity and Quality of Service

The principal elements which determine the value of service as well as of commodities are quality and quantity; in some cases the time and rate of delivery are also important elements. The quantity may be measured by meters—for example, gas meters, electric meters or water meters—or by count or time as in telephone service, or by the number of rides or distance traveled as in street railway service. It is comparatively easy to measure quantity of service in most of these cases, although effort and vigilance are needed to insure satisfactory meter accuracy and to adjust errors and satisfy complaints. But to specify the quality of service and to determine what (under given conditions) is good service and to ascertain whether the quality of service that has been specified is actually rendered is a much more difficult matter.

There is no absolute standard of quality of public utility service. In general, the better the service the more it costs, although the difference in cost between good and indifferent service is not the same under different circumstances. Thus in a large city continuity of service and uniformity of voltage in electric lighting may be secured at a smaller relative increase in cost than in a smaller city, and the requirements as to continuity of service and quality of transmission may be higher in an underground telephone system than in an overhead system. Aside, however, from any question of difference in quality of service due to different conditions, it is difficult enough to specify what constitutes safe and adequate service under average conditions, and very few public service commissions and very few utility companies have as yet attempted to do this for the electric utilities.

For gas service it has been done more or less successfully for many years, and many cities have ordinances which specify the service required, and in some cases gas inspectors make systematic tests to ascertain whether the service specified is being furnished, and often fines are imposed if it is not. The Bureau of Standards has made an extended study of the subject of specifications for manufactured gas and gas service, and a detailed report on the subject has been published. But no corresponding publication has been issued for electric service.

A similar thorough study of the electrical utilities should be carried out, and the requirements of good service under varying conditions formulated, and the relation between improved quality of service and the increase in the cost of the same determined. It is easy to make rules as to meter accuracy or as to variations of voltage at customers' premises or as to interruptions of service. But in framing such rules the possible increased cost of the service should be taken into account. The life of electric lamps and their candle-power vary greatly with a change of voltage, and hence good service requires steady voltage. This involves good construction, competent operation, correct instruments and careful inspection or voltage surveys.

Again rules with regard to frequency of street railway service, percentage of passengers seated in rush hours, character of cars and quality of the heating, lighting and ventilation of the same must all be made in view of the expense involved, for the public cannot get any more than it pays for, and under ideal regulation the requirements are so made that the public gets the maximum of service, considering quantity and quality, for every dollar expended.

Rates and Specifications

If a telephone company, for example, alleges that its rates are fair for the kind of service it is giving, and that its management is competent and progressive, there should be some well understood standards of performance by which to judge the said company and to determine whether the claim is justified. Again, if an electric light and power company claims that its relatively large capital investment is due to superior machinery and more spare units than usual and better con-

struction than the average, there should be standards of service as to efficiency and continuity and uniformity by which to determine whether such a claim is justified. A still more important reason for such standardization of service is that managers and directors of utility companies may know more definitely the kind of service they should strive to give the public and have a definite guide in planning extensions and improvements. Better service will generally involve more expensive equipment and more intelligent and hence more expensive labor.

Whether a manager is spending the stockholders' or the public's money, it is very desirable that as definite service specifications as possible be formulated for his guidance both in the equipment and in the operation of his plant.

This does not mean that such rules need be carried to unnecessary extremes, but that in a careful and conservative way, and with the co-operation of the utility companies, rules be prepared which are both reasonable and progressive. It would thus be possible for utility companies that chose to do so to conform to requirements so fully as to leave in the way of enforcement little for the commissions to do. In other words, they may be largely self-regulating, just as other corporations may obey the law voluntarily if the law is sufficiently clear and explicit so that it can be readily understood. For the information of the public it is also of importance to have such specifications, that it may be generally known what the companies are expected to do.

Managers of utilities can report their performance to the municipalities or public service commissions, and they can receive public credit for good performance as well as criticism for poor performance. Such specifications would serve as a guide to inspectors. Good inspection without them is hardly possible. In short, it seems as necessary for the public utilities to be standardized as to service and efficiency and to have regulations or specifications adopted for each class of utilities as it is to have specifications written to accompany contracts for other kinds of service.

Bureau of Standards

To make it clear why the Bureau of Standards is the proper federal agency to undertake this work it is desirable to explain briefly what the bureau is and how it does its work, and to give some examples of work of the kind proposed that it has already done.

The Bureau of Standards is a national standardizing and research institution, working chiefly in the fields of physics and chemistry and of electrical, mechanical and civil engineering. It is one of the newest of the federal bureaus and is not as well known as some of the others.

Foods and drugs, as you know, are studied and tested by the Bureau of Chemistry of the Agricultural Department; geological problems are studied by the Geological Survey; the problems of mining and the economic treatment of minerals are studied by the Bureau of Mines; meteorological problems and weather prediction are studied by the Weather Bureau, and a score of other bureaus have their various fields of activity.

But outside of all these there is a vast amount of work both of investigation and testing in connection with scientific and ordinary weights and measures, electrical and magnetic instruments and measurements, both scientific and commercial; photometric testing; thermometers, pyrometers, calorimeters and other heat-measuring instruments, optical instruments and light measurements, inorganic chemistry and the preparation of standard samples used in analysis; the testing of all kinds of structural materials, and of paper, textiles, etc., and the preparation of standard specifications and improvements in methods of testing.

It will be seen from what has been said that the bureau is investigating and testing many of the instruments used by the public utility companies, and it has an unrivalled equipment for such work. It has also investigated some of the problems of the utility companies and has an organization ready to take up further work as soon as the funds are provided to enlarge its staff.

The Bureau of Standards always seeks information at first hand, and in studying utility problems it works in the field as well as in the laboratory and freely consults those having valuable experience. As a national bureau it has the advantage of getting information from all parts of the country and from all classes of engineers and operators. Its engineers and experts are unbiased and absolutely independent and there is less likelihood of prejudice from personal interest or preconceived notions than if the investigations were of a local character.

Investigations Now in Progress

Reference has already been made to the investigations of the bureau on the measuring instruments used by utility companies, such as gas and electric meters, and electrical testing instruments, calorimeters, photometers and the methods of measurement and testing employed, as well as to the investigations of the bureau on the manufacture and distribution of illuminating gas.

One phase of the subject of gas manufacture that has received considerable attention is the most economical heating values for different kinds of gas. At the present time the bureau is making a study of this question with reference to gas made from crude petroleum as it is done on the Pacific Coast, this study being undertaken at the joint request of the Public Service Commissions of Oregon and California and a committee of the gas companies of the coast. The results of this study will be utilized by the state commissions in fixing the requirements of their respective states as to the heating value of the gas.

An extended study has been made of the damage caused to gas and water pipes, lead cable sheaths and reinforced concrete by the electric currents of street railways as they flow through the ground on their way back from the cars to the power houses, and of methods of preventing such damage, and very valuable results have been obtained. The handling of this subject by public service commissions is perhaps not expressly authorized by law, but as it is a case of the electric current used by one utility destroying the property of others it is of concern to these commissions, and the methods employed by the bureau are applicable generally.

An extensive study of the life hazard in electrical practice is now being made by the bureau (acting in co-operation with certain engineering societies) with a view of formulating rules of construction and practice to reduce the danger to employees and the public arising from electric light and power circuits. The use of electric power is constantly increasing, and the danger arising from lack of proper care in construction or operation is not alone to station operators and linemen but also to the unsuspecting public. Hence the importance of standardizing methods of construction and operation as far as practicable, so as greatly to reduce the danger, and formulating rules to that end that can be adopted by cities and public service commissions.

Closing Sessions of the American Economic Association

The sessions of the American Economic Association meeting at Minneapolis, following the opening meetings reported in our issue dated Jan. 3, 1914, were devoted mainly to the subjects of railroad rate-making, syndicalism and trust legislation.

Syndicalism

At the morning session of Dec. 30 Dr. John Graham Brooks, of Cambridge, Mass., gave a summary of his paper on "Syndicalism." This movement is a part of the great reaction all over the world against capitalism, the imperfections of the parliamentary system and the law's delays. If capitalization is as rotten as syndicalists generally believe it to be, there would seem to be some logic in their action. One of their plans is to arrange preliminary strikes by "direct action" leading up to a general strike later. Another feature of their plan contemplates an ideal state of labor co-partnership without the complicated organization of force based on law. If the existing order has failed as charged, possibly syndicalism may be justified as a sort of stinging whip from without to awaken society to the need for better things. The syndicalists believe that labor will eventually control capital. Syndicalism may be called, perhaps, the guerilla section of a great world-wide revolutionary movement. However, as so far put forth, syndicalism does not deserve an instant's serious consideration. It is important as indicating a tendency which may deserve serious study. When the trades union movement was first agitated the opposition to it was much more bitter and drastic than the criticism which is now applied to the Industrial Workers of the World. The Grange, also, was ridiculed forty years ago when it advocated regulation of railroads, parcels post and income tax and other commonplaces of to-day. The Grangers heralded a great truth, but the American people generally were too stupid to listen to it when the Granger agitation was attracting attention. Economists should give serious attention to the movement called syndicalism with open minds to see if it does not contain some measure of truth. There may be some great social changes coming to which the public may have to adapt itself.

Discussion

Prof. Karl F. Theodor Rathgen, of the Colonial Institute of Hamburg, Germany, disagreed with Dr. Brooks. Syndicalism is essentially a growth of the Romance nations, partly because in these nations there have been no great trades union organizations. It has very little hold on German workingmen. It is the socialism of the small workshop, not of the large enterprise. The movement will split up into one portion which will go into trades unions and into another that will gradually disintegrate because it underestimates the persisting force of society as organized at the present day.

Prof. M. B. Hammond, Ohio State University, declared that it is true that the trades unions have done little for unskilled labor, but the syndicalists have no well thought-out method of reform. Their methods can create annoyance but apparently nothing else. But, weak as syndicalism is in its philosophy, it nevertheless excites sympathy. It is no worse, perhaps, than the corruption existing as the result of capitalism.

Prof. R. F. Hoxie, University of Chicago, was opposed to a mystical concept of syndicalism and said that there has been a tremendous over-estimate of the strength of this upheaval in the American labor movement. The syndicalistic character of the Industrial Workers of the World, even, is not altogether established. Furthermore, that body has been a flat failure.

Prof. E. D. Howard, Chicago, Northwestern University, did not think that the Industrial Workers of the World is the forerunner of a revolution.

Mr. Roger W. Babson, Wellesley Hills, Mass., said that it is well to have concentrated wealth worried as much as possible, and syndicalism does this. Sooner or later there will be a fight between inherited wealth and creative ability. This may be the fight of the syndicalists. Mr. Babson compared the extremists under discussion to those taking part in John Brown's raid before the civil war. Their efforts may also be compared to a fire alarm which may possibly arouse the middle class of American society to put out the fire.

Prof. F. S. Deibler, Northwestern University, thought that syndicalism is only the more radical expression of the social discontent. It is probable that the radical elements will fail to get on well together.

The Trust Question

Professor Gray, of the University of Minnesota, presided at the closing session on the afternoon of Dec. 30. The principal paper was by Prof. Willard E. Hotchkiss, Northwestern University, on "Recent Trust Decisions and Business." In regard to the enforcement of the Sherman law the speaker said it may be a question whether the Attorney-General, with due regard to his oath of office, can in the future safely fail to take cognizance of specific acts of prima facie violation when the court has already established the illegality of similar practices. In the main the enforcement of the Sherman law has had, and still has, a patriotic and beneficial purpose. However, the serious need of a definition for "fair competition" is clear. Professor Hotchkiss thinks that "whenever there is a clear issue between immediate business peace and ultimate business standards ultimate standards must have the right of way." The impelling forces toward the formation of the great industrial trusts were market control and the profits of organization; business efficiency had little to do with the matter. The real question to-day is, "Have the trusts "made good"? The speaker devoted considerable attention to the efficiency of trusts and concluded that the alleged superior efficiency of combinations has not yet been established. He considered efficiency in the productive rather than the acquisitive sense. One good result of government trust activity has been to break the spell of the trusts in the public mind. The government is in possession of tremendous power, for the use of which there are comparatively few effective legal checks. Business welfare is bound to depend in many instances upon political responsibility and the character of officers rather than upon concrete legal restraints.

Discussion

Prof. E. Dana Durand, of the University of Minnesota, advocated an amendment to the Sherman law defining the limitations of fair competition. Of investigating the trusts, he said, there is no end. The amount of time and labor necessary for anything like a full investigation is enormous, and if such an investigation should be made, extending over a period of perhaps twenty years, its conclusions might be questioned at the end of that time. Inasmuch as the trusts took in most of the efficient concerns in the various lines affected, it would be unfair to compare them with the concerns remaining outside. But if a trust is efficient, should it be continued merely on that ground? Nearly all of the great combinations are artificial concerns. Railroads are recognized as monopolies, but to regulate monopoly of the manufacturing industry is a far different proposition. Another question to be asked is, If the trusts are dissolved, can competition be restored?

Professor Durand held that it can be in the long run. At any rate, no new combination could be formed. It is to be remembered that a combination may be all right if it has no monopolistic power. The bringing of a suit for the dissolution of a trust or for violation of the Sherman law should not rest in the discretion of a single individual. There should be a permanent government industrial commission to advise the Attorney-General and the Supreme Court.

Prof. W. A. Rawles, Indiana University, said that most of the trust's power for evil has sprung from its artificial advantages. He favored exhaustive investigations by an interstate industrial commission, believing that the wide divergence of opinion on the trust question must be due to lack of data. He advocated the amendment of the patent laws and federal control over industrial capitalization and accounting.

Dr. F. L. McVey, president University of North Dakota, said that the present government could hardly be held responsible for the slow-down in business. He considered the present slackening in business as inevitable from the history behind the anti-trust movement. "Big business" is doubtless a legitimate present-day development, but it should be put on an efficiency, not a speculative, basis. Reasonable pooling of combination and supply may be permitted.

Prof. J. E. LeRossignol, University of Nebraska, said that he does not see that the public has received any immediate beneficial effects from the dissolution decisions of the United States Supreme Court. He thought it better to tax trusts than to control them.

Prof. G. E. Putnam, University of Kansas, advocated the establishment of some standard of certainty in the law as to what constitutes unfair methods. The question of the efficiency of the trusts is still open. Some combinations have a reason for existence, especially where prices are subject to sharp fluctuations. The speaker asked if the dissolution of the trusts will not result in pooling, which is difficult to detect, and which may tend to become permanent if there is sufficient at stake. He suggested government price regulation, properly limited, in the case of some combinations engaged in interstate commerce and advocated the establishment of an interstate bureau of industrial commerce, with limited power of control, and adapted to advise with the Department of Justice.

In closing, Professor Hotchkiss said the investigation of the trust problem must go on. He did not say that all trusts are inefficient, although the weight of recent economic opinion seems to lean that way. In relation to the comparison with public service corporations, he asked if the monopoly of anthracite-coal production has not essentially the attributes of the public-service corporation.

The paper by Dr. B. H. Meyer, of Washington, D. C., member of the Interstate Commerce Commission, on "Railroad Rate-Making," will be abstracted in a later issue.

Other Business

At the business sessions of the American Economic Association two resolutions of some general interest were adopted. One introduced by Prof. Frank A. Fetter, of Princeton University, provides for the appointment of a committee of three to examine and report upon the present situation in American educational institutions as to liberty of thought, freedom of speech and security of tenure for teachers of economics. The second resolution, introduced by Prof. E. Dana Durand, of the University of Minnesota, requests the government to send official delegates to international meetings or congresses of scientists of acknowledged reputation where European countries are officially represented. The executive committee of the association was also instructed to consider the possibility of dividing the society into Eastern and Western sections.

Dr. John H. Gray, professor of economics in the University of Minnesota, was elected president of the association, and Prof. A. A. Young, of Cornell University, was elected secretary and treasurer. The next annual meeting will probably be held in Princeton, N. J.

Public Service Commission News

Illinois Commission

The five members of the new State Public Service Utilities Commission of Illinois have been appointed by Governor Dunne. Mr. James E. Quan, of Chicago, the chairman, is a personal friend of the Governor and has been engaged in the wholesale grocery business. His present appointment is his first public office. He is a Democrat. Mr. Richard Yates, of Springfield, lawyer, is fifty-three years old and was Governor of Illinois from 1901 to 1905. He is a Republican. Mr. Frank H. Funk, of Bloomington, was formerly State Senator. He was the Progressive party candidate for Governor in 1912. Mr. Walter A. Shaw, of Chicago, is a civil engineer and a member of the Western Society of Engineers and the American Waterworks Association. He has been a member of the Rivers and Lakes Commission of the State and has been president of the American Engineering & Construction Company of Chicago. Mr. Shaw obtained his college degree as civil engineer from Valparaiso University. He has done engineering work in connection with sewerage in Chicago and Louisville. He is a Democrat. Mr. Owen P. Thompson, of Jacksonville, is a lawyer and resigned as presiding justice of the Fourth Appellate District of the State to accept appointment as a member of the board. He is a Democrat.

The commission will have headquarters in Springfield, but will also have an office in Chicago and will divide its time between the two cities.

Massachusetts Commission

The Massachusetts Public Service Commission has denied the petition of the Berkshire Street Railway for authority to build a line up Mount Greylock, the highest peak in the State. The board points out that the line would be used only for a short period yearly, that the interest charges upon its estimated cost of $1,100,000 would amount to $55,000 per year, and that the line could not pay a proper return without excessive fares.

Maryland Commission

The Consolidated Gas, Electric Light & Power Company of Baltimore has notified the Maryland Public Service Commission that it cannot furnish electric service along the Liberty Pike from Rockdale to Randallstown without heavy loss. The demand upon the company to provide the service was made by the Roslyn Grange and several individuals who alleged that a contract had been made by the Patapsco Electric Company to furnish this service. The Patapsco company was acquired by the Consolidated system.

New Jersey Commission

The Board of Public Utility Commissioners of New Jersey has issued an order authorizing the Public Service Railway to sell $620,000 first mortgage bonds of the North Hudson County Railway at not less than 99½, under a system of competitive bidding. The board recently refused to sanction the sale of this issue at 97 to the Fidelity Trust Company, holding that in justice to its stockholders the company was obligated to obtain as high a price as possible.

Current News Notes

GROWTH OF ELECTRIC SERVICE IN CHICAGO.—During the year 1913 the Commonwealth Edison Company increased its total connected load by the equivalent of about 2,400,000 50-watt units. Of this nearly 61,000 hp is due to increase in the railway load. The number of customers increased 31,098, or 17 per cent, and the output of energy for commercial lighting and power increased 22 per cent. The total connected load is equivalent to more than 13,000,000 50-watt units. The total rating of generating stations is about 350,000 kw.

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EXAMINATION FOR ASSISTANT ELECTRICAL ENGINEER.—An examination for assistant electrical engineer in New York State hospitals, departments and institutions will be held on Jan. 17. Candidates who are graduates in mechanical or electrical engineering must have one year's practical experience in electrical work or in the operation of stationary steam engines and electrical machinery. The salary is from $480 to $900 per annum and maintenance. Further information may be had from the State Civil Service Commission, Albany, N. Y. No applications mailed after Jan. 7 will be accepted.

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PROGRESS ON BOSTON EDISON WELFARE BUILDINGS.—The Edison Electric Illuminating Company of Boston has recently issued a twenty-page illustrated booklet outlining the features of the Welfare Buildings now under construction at the company's service headquarters on Massachusetts Avenue, Boston, and emphasizing the policy of the company with regard to their use. The company now has about 2000 employees in its 700 sq. miles of territory and is rapidly pushing the construction of three buildings specially designed to facilitate the work of the Welfare Bureau. The group consists of a library, a recreation building and a combined auditorium and dining hall, all being of fireproof construction, with terra-cotta block walls of cement finish, slate roofs and concrete foundations. The equipment of the buildings will provide practically every convenience common to the best clubs and ample provision will be made for indoor and outdoor sports. The auditorium will seat 600 persons and 400 when set up as a café.

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SOCIETY MEETINGS

METER CONFERENCE OF O. E. L. A.—At Cleveland, Jan. 16, the meter committee of the Ohio Electric Light Association will hold a meeting for men interested in meter work, to which all public-service companies in the State are invited to send representatives. The session will be held in the Cleveland Electric Illuminating Company's new meter building, 6512 Carnegie Avenue, and Mr. J. T. Kermode will tell of the meter methods of the Cleveland company.

* * *

WISCONSIN ELECTRICAL CONTRACTORS.—The annual meeting of the Electrical Contractors' Association of Wisconsin will be held in the Hotel Wisconsin, Milwaukee, on Jan. 12, 13 and 14, beginning at 2 p. m. on the first day. The afternoon session of Jan. 13 will be open, and prospective members as well as jobbers and manufacturers or their agents are invited to attend. Mr. Albert Petermann, 626 Lloyd Street, Milwaukee, is secretary of the association.

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MEETING OF NEW YORK STATE ELECTRICAL CONTRACTORS.—The Electrical Contractors' Association of New York State will hold its annual meeting at Shanley's in New York City on Jan. 20. There will be a closed session in the morning and a reception in the afternoon. During their stay in the city the delegates will be the guests of the Metropolitan Electrical Contractors' Association of New York City, which will provide a luncheon in the afternoon and a theater party followed by a supper and smoker in the evening.

* * *

MEETING OF PHILADELPHIA SECTION, I. E. S.—The Philadelphia Section of the Illuminating Engineering Society will meet Jan. 16, 1914. A paper, "Deficiencies of the Method of Flicker for the Photometry of Lights of Different Colors," will be presented by Prof. C. E. Ferree, and Dr. J. N. Rhoades will present a short paper on "A Reflecting Marker for All Books." As usual the meeting will be preceded with a dinner at the Engineers' Club, at which place the meeting of the section will also be held.

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ELECTRIC CURRENTS AND NERVE IMPULSES.—In an address before the Society for Experimental Biology and Medicine, New York, Dec. 17, Dr. A. C. Crehore and Mr. H. B. Williams discussed the rate of travel of electric currents in conductors containing distributed capacity, considered with relation to the propagation of nerve impulses. A definite fraction of a second is, for example, required for a sensory impulse to travel from the finger tip to the brain, and the authors showed that the speed attained is exactly the rate of movement to be expected of an electric charge traversing a cable with similar distributed capacity.

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INSTITUTE OF RADIO ENGINEERS.—On Jan. 7, at the annual meeting of the Institute of Radio Engineers, held at Columbia University, New York, officers for the coming year were announced at follows: Dr. L. W. Austin, president; Dr. J. S. Stone, vice-president; Mr. J. H. Hammond, Jr., treasurer; Mr. E. J. Simon, secretary, and Messrs. R. H. Marriott, J. L. Hogan, Jr., R. A. Wiegant and G. Hill, members of the board of managers. Following the election of officers Mr. R. H. Marriott read an interesting paper on the subject of range variation in wireless telegraphy. His paper was notable in being based entirely on observations taken in connection with regular commercial operation. Mr. Marriott's paper was discussed by Dr. Stone, Mr. Hogan and Dr. Lee DeForest.

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MEETING OF WESTERN SOCIETY OF ENGINEERS.—At a joint meeting of the electrical section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers on Dec. 29, Mr. H. W. Young, of the Delta-Star Electric Company, Chicago, presented a paper entitled "Moderate-Capacity Outdoor High-Tension Substations." The author told of the increasing need of substation apparatus designed to serve farmers, small-motor customers and villages along the routes of high-tension lines, and gave descriptions of types of apparatus employed, illustrating many of the examples with lantern slides. Concerning continuity of service with present types of transmission equipment, Mr. Young said that interruptions under ordinary conditions are less frequent than those experienced by operators of independent plants. The paper was discussed by Messrs. O. Wingard, E. W. Allen, L. L. Perry, William B. Jackson, H. B. Gear, J. R. Cravath, L. N. Boisen, F. C. Van Etten, M. G. Lloyd and D. W. Roper. The report of the nominating committee, signed by Messrs. R. F. Schuchardt, J. R. Cravath and William B. Jackson, was read, announcing nominations for officers of the electrical section as follows: Chairman, Mr. F. J. Postel; vice-chairman, Mr. H. M. Wheeler, and member of the executive committee, Mr. E. W. Allen.

The 150,000-Volt Big Creek Development—II

Construction of 150,000-volt buses in station and arrangement of high-tension oil switches—Steel-tower transmission lines with nine-disk suspension insulators—Large synchronous condensers in substation

THE Big Creek development of the Pacific Light & Power Corporation (as noted in the first section of this article, which appeared in these columns last week) employs a line potential of 150,000 volts to transmit an ultimate output of 120,000 kw to the city of Los Angeles, 240 miles distant. In the preceding section a general description was given of the system of dams, reservoirs, pipe lines, penstocks and power houses, particular reference being devoted to Power House No. 1.

The tail-water from this upper plant, supplemented by the discharge of Pitman Creek, which empties into Big Creek from an adjacent watershed at a point about 1000 ft. above Plant No. 1, is impounded behind a dam of the arched type, 288 ft. long and 73 ft. high, which has been thrown across Big Creek about 500 ft. below Plant No. 1. Its crest elevation is 4805 ft. Provision for flashboards has been made as in the other dams, and a sluiceway controlled by a 72-in. gate is provided. This dam diverts the flow of water into a second tunnel 12 ft. in diameter and 21,300 ft. long, driven through the native granite on a grade of 3.2 ft. per 1000 ft. and provided at its entrance with a gate and screen similar in general design to those at the headworks of the first tunnel.

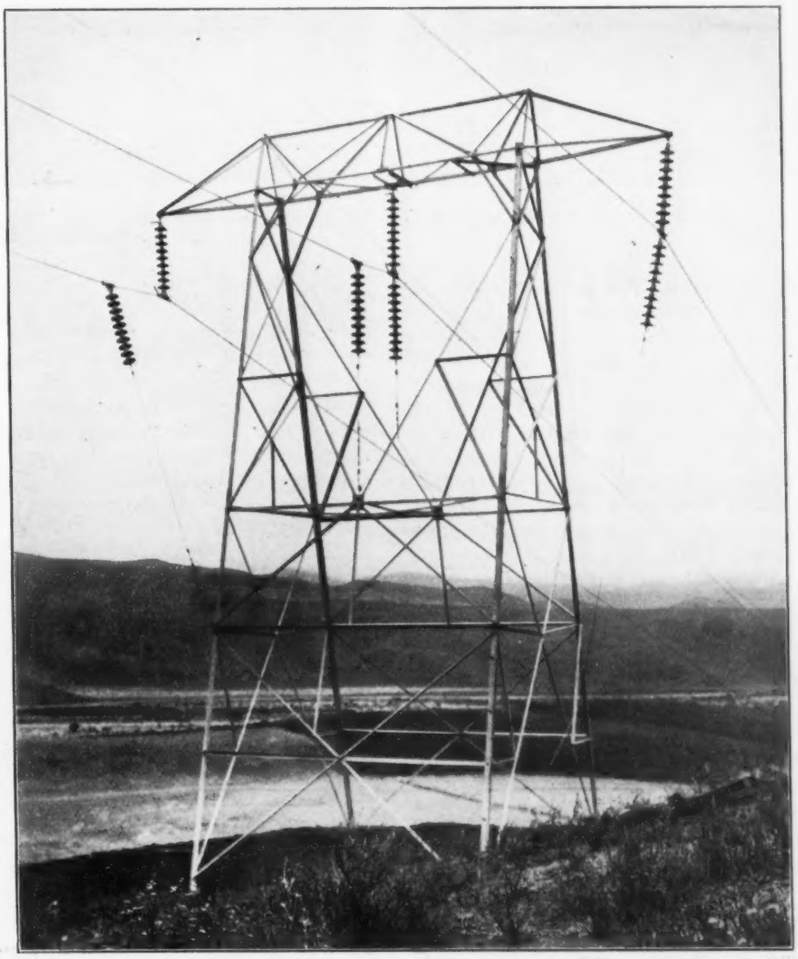


FIG. 14—150,000-VOLT TRANSMISSION-LINE TOWER, SHOWING NINE-DISK INSULATORS AND METHOD OF TYING DOWN CONDUCTORS

The tunnel ends in a concrete-lined surge tank 120 ft. high. The water flows from this tank through an outlet controlled by a gate 9 ft. in diameter into a 108-in. pipe 250 ft. long which connects at its lower end with a pair of pressure pipes leading to the units in Power House No. 2. With the exception of a difference of two fewer buckets in the wheels, the hydraulic features of the second station are so nearly the same as at the first station that further description is unnecessary. As stated above, the head on the second station is 120 ft. lower than that on the first, but the units are of the same rating, and on account of the greater amount of water required per horse-power of output the second station will have one less machine in the final development of the project.

In each station each pair of waterwheels drives a 50-cycle, 6600-volt revolving-field type generator of 17,500-kva rating at the normal speed of 375 r.p.m., this being the continuous rating of the generator. The generators are the largest of their type thus far built and are sufficient in size to give 21,000 kva for one minute and 25,000 kva momentarily. The design permits the operation of each rotor at 100 per cent excess speed without excessive strain upon the rotating parts. The weight of each generator in Plant No. 1, including the shaft but excluding the waterwheel runners, is 292,250 lb., the rotor, shaft and wheel runners weighing together over 200,000 lb.

From the generators the leads are carried in conduit to the 6600-volt oil-switch room located on the third floor of the station, and thence to 6600-volt duplicate buses on the second floor. All 6600-volt buses are installed in separate concrete chambers with individual cells for generators, transformers and other apparatus. One bank of main transformers is provided for each generating unit, but the switching connections are such that either bank may be operated from either

6600-volt bus and the high-tension sides may be thrown upon either of two sets of 150,000-volt transfer buses by the operation of suitable remote-controlled oil switches. Connections may be made between either high-tension bus set and either of the two transmission lines, through additional oil switches.

Each main transformer is rated at 5833 kva and is of the single-phase, oil-insulated, water-cooled type,

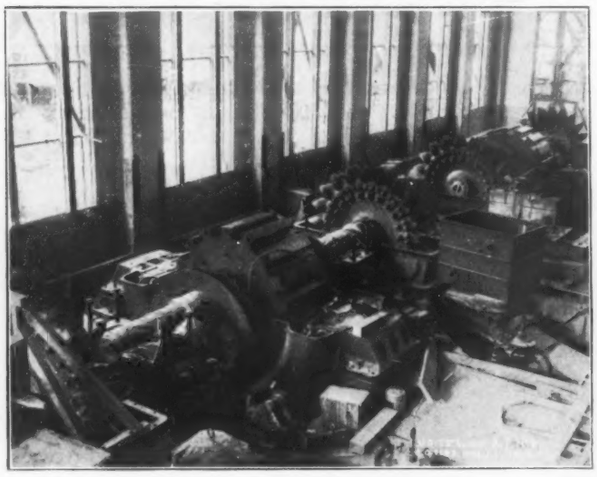


FIG. 15—WATERWHEEL UNITS NOS. 1 AND 2 IN POWER HOUSE NO. 2

one spare unit being provided. The primaries are connected in closed delta and the secondaries in Y, giving 86,700 volts per phase and 150,000 volts between five wires. The neutral of the Y is grounded, but the transformers are insulated for operation ungrounded, so that the full transmission pressure of 150,000 volts may be used with or without the ground. The neutral ground is connected through a current transformer which operates an alarm system in case of any decided unbalancing.

To provide flexibility in the high-tension bus and switching system it was necessary to utilize two separate floors in the upper part of the plant for proper

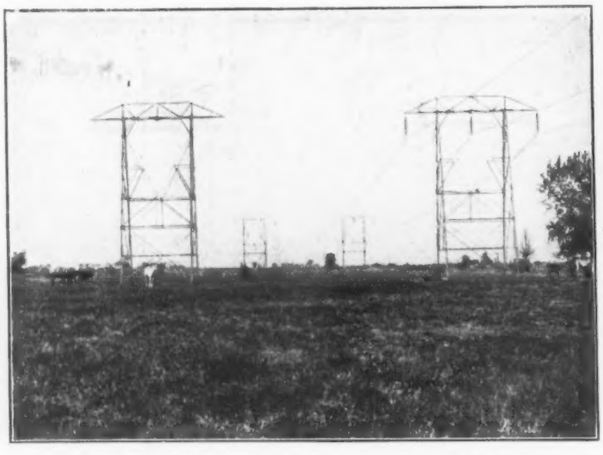


FIG. 16—DUPLICATE 150,000-VOLT TRANSMISSION LINE

housing of the bus equipment. The buses are all of 2-in. wrought-iron pipe and all connections are of 1.25-in. pipe. These large diameters were used, and the corners of metallic line fittings were rounded off, to reduce the chances of corona loss. The high-tension leads from the transformers are carried upward in vertical runs to strain insulators supported from the roof framing, horizontal strain insulators of the multiple-disk type being used on each side of the conductors at each floor level to stiffen the construction. The standard spacing of horizontal 150,000-volt buses is 8 ft. The outgoing lines are carried through choke coils near the roof and pass out of the building through wall openings protected by canopies. Interior bushings are not used.

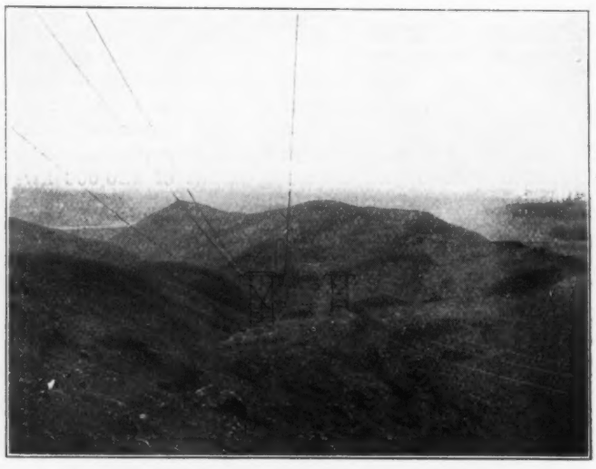


FIG. 17—TRANSMISSION-LINE SPANS, SHOWING CHARACTER OF COUNTRY TRAVERSED

The plant is equipped with aluminum-cell lightning arresters and the usual horn-gaps, the former being installed in a compartment above the 6600-volt oil switches, and the latter on insulators carried on a steel tower located on the roof. Outgoing lines are dead-ended on strain insulators attached through special structural steel framing to the building frame. The arresters in Plant No. 1 have dead and grounded tanks, and the horn-gaps, which are equipped with indicators, are operated by mechanical remote control.

The 150,000-volt switches are installed in independent three-pole units surrounded by concrete compartments which practically inclose the equipment.

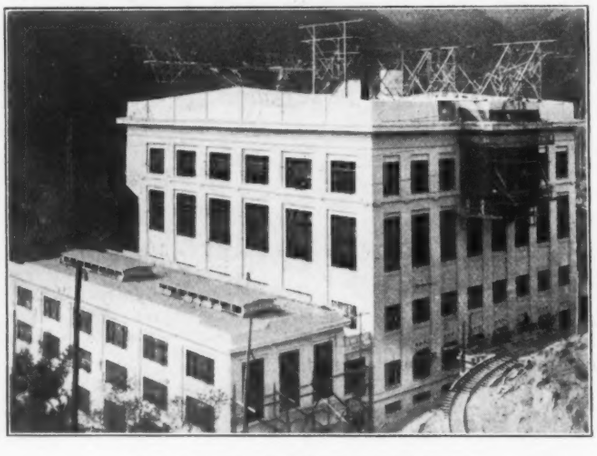


FIG. 18—EAGLE ROCK SUBSTATION

Corridors are formed by wall openings of sufficient size to enable any switch unit to be removed and the bus chambers for high-tension service are separated from the switch compartments by a concrete barrier 12 ft. high.

The exciter generators, rated at 150 kw, operate at 750 r.p.m. and are of the interpole compound-wound

type, each being capable of exciting two main generators. The machines are designed with shunt windings arranged so that the halves can be connected in series for self-excitation at 250 volts or in parallel for excitation by smaller generators on a separate basis. Two sets of regulating exciters are installed, each consisting of a 250-volt motor-driven exciter controlled by a Tirrill regulator, connected in series with a 125-volt exciter without a regulator. By differential connections a voltage range from 125 to 0 is secured.

The electrical equipment of Plant No. 1 was furnished by the General Electric Company, and that of Plant No. 2 by the Westinghouse Electric & Manufacturing Company. The generators, transformers and oil switches in each station were designed for similar service. In Plant No. 1 all 150,000-volt oil switches are of the manufacturer's "K-21" type, each consisting of three single-pole elements mounted in separate tanks, the space occupied being 6 ft. by 20 ft. by 10 ft. Including the oil, the weight of one of these switches complete is 14 tons, and the total weight of each transformer in Plant No. 1, with oil, is 79 tons. The 6600-volt switches in Plant No. 1 are of the "K-3" type. All the oil switches in the 6600-volt and 150,000-volt circuits belonging to this station are of the non-automatic type.

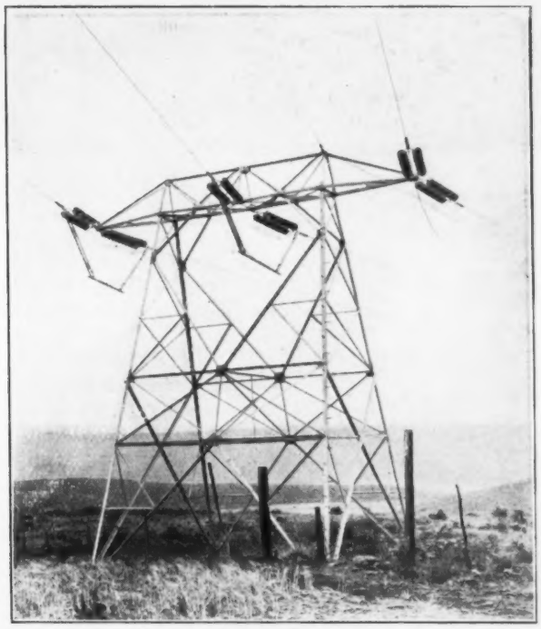


FIG. 19—ANCHOR TOWER

In Plant No. 2 the 6600-volt switches are of the manufacturer's "C" type and the 150,000-volt outfits of the "GA" type. The transformer and 150,000-volt switch weights in this station are respectively 45.5 tons and 30 tons. Both stations are designed to accommodate apparatus built by either of the two foregoing manufacturers in making future extensions. The impulse-wheel units, governors and regulating equipment, hydraulically operated gate valves and central oiling system in each plant were designed and manufactured by the Allis-Chalmers Manufacturing Company, of Milwaukee, Wis.

The exciters in Plant No. 2 are rated at 200 kw each, two being used. These machines are of the non-interpole type, but are compound-wound with two shunt circuits on a common set of poles. The series winding is used in connection with hand regulation from the remotely controlled exciter switchboard, but normally one of the two shunt windings is connected across the armature and self-excited through the customary rheostat, the other winding being separately supplied from a sixty-cell storage battery controlled by a special Tirrill regulator. The bus connections are the same in general arrangement as in the first station, and in both disconnecting switches are installed on each side of every oil switch carrying high voltage. The two outgoing lines from station No. 2 are multiplied into those from the first station without local switching. Interior 220-volt three-phase service for motors, etc., is available in each station. The lighting is handled by a 220-110-volt three-wire system. The plants are illuminated by tungsten lamps throughout and the intensity of illumination varies from 3-ft. candles in the generator room and on the switchboard gallery to 1.5-ft. candles in the basement.

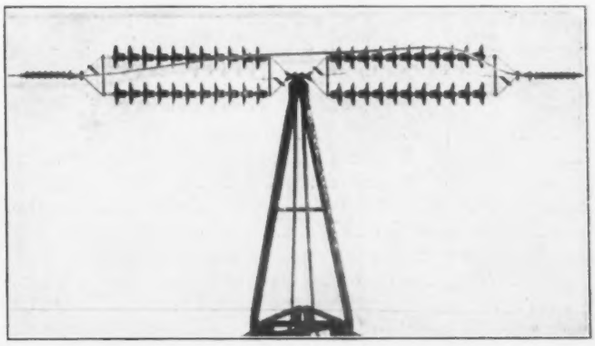


FIG. 20—INSULATOR CONSTRUCTION AT ANCHOR TOWER LOOKING UPWARD

150,000-Volt Transmission Lines

The transmission lines from the Big Creek development are among the most notable thus far operated, both on account of their great length and the extremely high voltage employed. From Big Creek to the Los Angeles substation, formerly called the Eagle Rock substation, the distance is 241 miles. There are two steel-tower lines, each carrying a three-phase circuit with the conductors in a horizontal plane, the towers being spaced 660 ft. apart except in regions exposed to sleet, where the spacing has been shortened.

FIG. 21—SYNCHRONOUS CONDENSER IN EAGLE ROCK SUBSTATION

The towers are of the Milliken type, over 3400 having been used. Conductors are sagged for a minimum clearance of 25 ft. above ground. The towers are carried on structural-steel foundations extending about

6 ft. into the earth. The principal members of these foundation structures are 6-in. by 3.5-in. angles.

The lines are placed 80 ft. apart on centers on a right-of-way 150 ft. wide. About 65 per cent of the towers are standard, each weighing 5600 lb. The standard height from the ground to the cross-arm is 43 ft. The conductors are carried by Locke No. 2565 insulators, nine disks being used in series on suspensions. On angle and anchor towers two sets of eleven disks each are used in parallel on each side of the tower. Each disk unit has been given a dry flash-over test of 90,000 volts and a rain test at over 56,000 volts.

Data on Line Construction

More than 6,000,000 lb. of cable was required for the two lines. The conductor is of aluminum with a steel core, the outside diameter being 0.95 in. and the weight per mile 4058 lb. The core is composed of seven strands of double-galvanized plow-steel wire 0.105 in. in diameter per strand, and the maximum stress figured for the conductor is 7500 lb. The standard towers were designed to withstand the pull resulting from the breakage of two conductors on the same side of a tower, and anchor towers were designed to meet the condition of all three conductors broken on one side, with a broken ground wire, and a pull at right angles to the line sufficient to permit their use as angle towers for making a line turn of 60 deg. A seven-strand galvanized Siemens-Martin steel cable of 7.5 tons ultimate strength is used as a ground wire. The conductors are spaced about 17.5 ft. apart horizontally. The line crosses the Sierra Nevada and Tehachapi ranges at altitudes of from 4500 ft. to 5000 ft. and also traverses a rolling country. The large diameter of the conductor is an important factor in the elimination of corona losses.

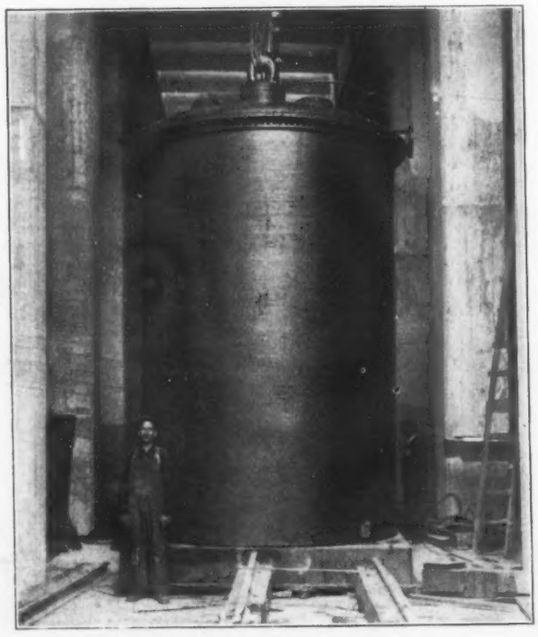


FIG. 22—4500-KVA TRANSFORMER REDUCING FROM 150,000 VOLTS TO 18,000 VOLTS

At Bakersfield, Cal., 135 miles from the generating plants, is situated a concrete and steel switching station at which the incoming and outgoing transmission lines may be cross-connected or parallel through oil switches. Plans are made for a future transformer installation here and for handling an additional 150,000-volt line. The present installation of oil switches is of the non-automatic, hand-operated type, but remote control will be employed later.

A receiving substation has been built about 9 miles from Los Angeles, the building being a 168-ft. by 110-ft. reinforced-concrete structure housing the two incoming lines from Big Creek, transformers, compensators and synchronous condensers utilized in voltage regulation.

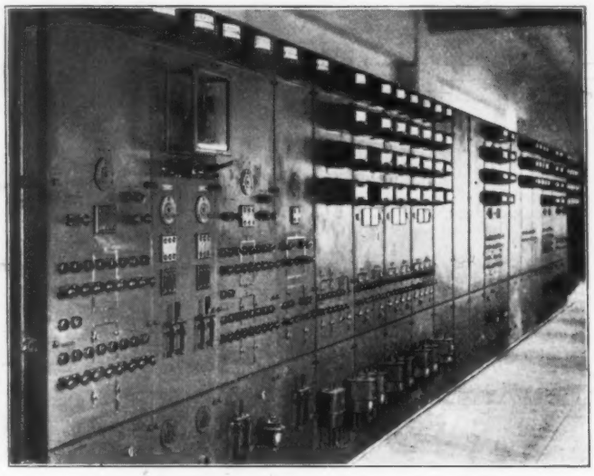


FIG. 23—MAIN SWITCHBOARD AT EAGLE ROCK SUBSTATION

The distribution system includes both 72,000-volt and 18,000-volt lines, and ultimately the substation will care for three incoming lines and two 72,000-volt and six 18,000-volt feeders, besides housing four 15,000-kva synchronous condensers.

The substation is five stories in height and is so laid out as to be readily extended. There are at present four 13,500-kva transformer banks supplying energy from the 150,000-volt buses to the 72,000-volt and 18,000-volt buses. Two 15,000-kva synchronous condensers are run off the 18,000-volt buses through banks of three 5000-kva transformers delivering 6600 volts to the condensers. Each condenser is equipped with a direct-connected exciter, and a future 3000-kw direct-current generator for railway service may be attached.

In order that pressures of 150,000 volts may be maintained at both ends of both transmission lines the synchronous condensers must each supply 12,300 kva lagging and the generators 11,750 kva. The voltage rise due to line capacity without condensers is 9.3 per cent at no load. The General Electric Company furnished all the 150,000, 72,000 and 18,000-volt switching equipment, the main switchboard, one rotary condenser, six transformers and auxiliary apparatus. One synchronous condenser, the remaining transformers and auxiliary apparatus were provided by the Westinghouse Electric & Manufacturing Company.

The transformers are interchangeable, and all are of the oil-insulated, water-cooled type. The substation is divided into sections according to the line and bus voltage handled, with a central assembly aisle served by an 85-ton electric traveling crane. The Big Creek system is operated in parallel with two 50,000-volt lines from the Kern River plant of the company through compensators of 10,000-kva total capacity. The buses are arranged in duplicate to give increased flexibility, but on account of the space requirements of the delta-delta connections of the transformers it was necessary to use 72,000-volt cable in the transformer room. Iron pipe is employed for buses and for the other high-tension connections. The only automatic switching equipment is that used on 72,000-volt and 18,000-volt feeders.

Radio Service on the Lackawanna Railroad

Service operation of the radio-telegraph equipment used for communicating between moving trains and stations along the route of the "Lackawanna" Limited. By John L. Hogan, Jr.

THE problem of signaling from fixed stations to moving trains has been attacked from many angles, with varying degrees of success. By the use of commercial radio-telegraph equipment the officers of the Delaware, Lackawanna & Western Railroad have succeeded in maintaining communication between the New York to Buffalo "limited" and the wireless stations at New York, Scranton, Binghamton and Buffalo. The equipment which makes this possible, and especially the outfit installed aboard the train, is proving of great interest.

On the roof of the Scranton (Pa.) depot the railroad electrical staff has erected a tower 60 ft. in height, giving a total elevation of about 150 ft., and from this to the 175-ft. stack at the shops, 750 ft. away, is slung a four-wire flat-top antenna. Lead wires are brought from the eastern end over the edge of the building to the operating room on the second floor, as may be seen in Fig. 2. In the station the telegraph department has installed a 2-kw radio-telegraph equipment purchased from the Marconi company. The transmitter includes a Crocker-Wheeler motor-generator, which is installed in the basement and which, running at 1750 r.p.m., converts the sixty-cycle, three-phase central-station energy into 500-cycle energy at 250 volts for the radio outfit. The 500-cycle current is led through a sending key to a transformer, where the emf is stepped up to about 20,000 volts and is used to charge a bank of six copper-plated Leyden jars (total capacity 0.024 microfarad), which discharge 1000 times per second through a multiple-plate quenching spark-gap in the usual manner, giving a high-pitched musical spark. Inductively coupled transmitting circuits are used, the radio-frequency transformer and inductances being wound of strip copper in flat spiral form, clock-spring fashion. A hot-wire ammeter in the antenna circuit shows a reading of about 12 amp when the station is sending on a wave-length of 1600 m. The natural period, capacity and radiation resistances of the antenna have not yet been measured.

The station is fitted with a small control panel carrying voltmeter, ammeter, wattmeter, frequency meter and generator field rheostat. The motor-generator is started and stopped by two signal relays operated by a small hand switch. The receiving tuner is of the inductively coupled type, with a switch for connecting the detector circuits directly to the antenna for "picking up" under broad tuning adjustment. The detector used is of the double crystal form and requires very little attention. Not much trouble is experienced from interference, so that the broad-tuned circuit is used almost altogether for working with Binghamton and the train. It is found that the signals are somewhat reduced by insertion of the receiving transformer, but on the direct coupling messages from Binghamton (62 miles away) may easily be copied on a typewriter. The station has been inspected and licensed by the United States Department of Commerce and has had assigned to it the call letters *W T P*.

At the Binghamton (N. Y.) station two 175-ft. self-supporting steel towers have been erected 400 ft. apart. A four-wire flat-top antenna stretches between these and has its lead wires taken from the middle point. The apparatus is installed on the upper floor of the Binghamton depot and comprises exactly the same units as used at Scranton. Fig. 1 shows the change-over hand

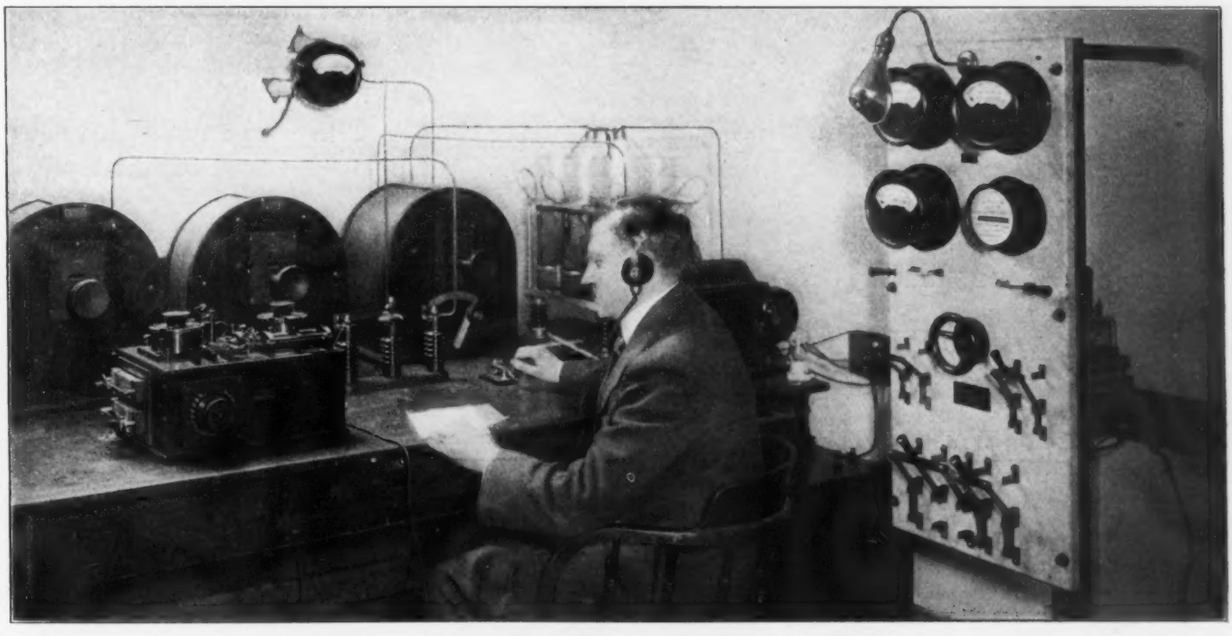


FIG. 1—INSTRUMENTS AT BINGHAMTON STATION

switch (on the table just to the right of the receiving tuner) used to transfer the antenna from sending apparatus to receiver. The quenching gap and blower are seen just behind the operator. In this station also the transmitter is of the 500-cycle musical-spark type. The call letters used are *W B T*.

On the "Lackawanna limited" the antenna is formed from four rectangles of wire, each of which is carried on insulators at the corners of one of the four forward cars. These insulators and their supporting posts can be seen in detail in Fig. 4, which also shows the link connection used between cars. The four-car aerial as a whole forms a "flat top" about 250 ft. long, 10 ft. wide and 12 ft. above the rails. The wires clear the steel cars by less than 2 ft., so that the radiating power of the system must be very small. A lead is taken from the middle of the antenna through the roof of the third car into a small compartment which contains the telegraph apparatus as shown in Fig. 3.

The instruments aboard the train are similar in principle and operation to those at Scranton and Binghamton, but are of only 1-kw rating. A Crocker-Wheeler motor-generator was rewound to operate on 30 volts direct current from the car-lighting generator, which carries on its line a set of storage cells. Drawing about 40 amp, this motor-generator provides 270-cycle alternating current at 250 volts for the radio transmitter, which includes a ten-unit quenching gap, three glass-jar condensers of 0.004 microfarad each, and the usual radio frequency transformers. No radiation ammeter is provided, but the antenna current is stated to be about 35 amp. In consideration of the probable high capacity and low equivalent resistance of the train aerial, this large value is not surprising, though it indicates an antenna resistance well below 1 ohm. Fig. 3 shows how the receiving tuner, of the type described above, is mounted on the wall of the operating compartment. The train equipment has not as yet been inspected by the government but the call letters *W H T* are used temporarily.

For the first few trips after the stations were put in operation it was not found possible to communicate between the train and Scranton or Binghamton further than 6 miles or 8 miles, and at some points even within that distance it was impossible to exchange signals until

FIG. 2—TOWER AND AERIAL AT SCRANTON

the train moved into a more favorable position. In the course of several weeks' experiments a greater familiarity with the instruments, together with a few substitutions and readjustments, permitted continuous extension of the signal range. It is now possible to communicate with stations in New York until the train reaches Dover, N. J., about 40 miles out. Fifty-three miles further, after passing Stroudsburg, Pa. signals may be sent from the train to Scranton, about 50 miles away, and from that time on Scranton is able to read all that is sent by the train operator. Signals from Scranton are first picked up when the train is near Tobyhanna, about 30 miles away. Shortly after passing Scranton, signals may be exchanged with both that station and Binghamton, and then with the latter only

FIGS. 3 AND 4—INSTALLATION ON TRAINS AND ANTENNA SUPPORTS AND CONNECTIONS

until Owego is left behind. After passing about 30 miles from Binghamton no telegraphing is possible until the train passes Mount Morris, N. Y., when the commercial station in Buffalo may be reached.

On Dec. 21, 1913, through the courtesy of the telegraph and telephone department of the Delaware, Lackawanna & Western, the writer observed the train and Scranton outfits in operation, and telegraphed from the train while approaching Scranton, listening to signals from the train while it passed on from Scranton to Binghamton. The novelty simply of telegraphing by radio while slipping over the rails at 50 miles an hour or more is striking enough, but probably the most astonishing point is the ease with which the high-pitched spark signals may be read in spite of the roaring and snapping wind and rail noises which are heard on any train in swift motion. Perhaps still more interesting is the rapid variation of signal strength which takes place as the train winds in and out along the valleys and among the steep hills east of Scranton. With location and direction of travel favorable the signals may be several hundred times audibility, and then, within only ten or fifteen seconds, a turning which places the train broadside to the transmitter or behind a screening hill may so weaken the received impulses that it is necessary to squeeze the earpieces tight against one's head to hear the dots and dashes at all. When passing under a steel bridge the signals were noted to weaken greatly and immediately afterward to regain normal strength, possibly because of the detuning effect of a change in the antenna's effective capacity. When nearly a mile from Scranton the train ran through a tunnnel probably from 600 ft. to 800 ft. in length and 60 ft. below the earth's surface, yet Scranton's signals were received without interruption and with only slight decrease in loudness, even when the train was entirely underground. In receiving signals transmitted from the train in motion the same irregular

changes in intensity are observed. It has not yet been determined whether these are due to the changes in the bearing of the train and the consequent altering of the directive effects as regards a communicating plant, to the constantly changing configuration and character of the land between the two stations, or to some other cause.

The railroad officials have already found use for the radio service in the ordering of a relief train conductor, and in another instance of a locomotive to replace one which had broken down. Moreover, a spare car to accommodate unexpectedly large passenger traffic has been secured by wireless, and a physician has been called to attend a passenger suddenly taken ill while the train was in motion. Commercial messages for passengers have been sent, and in one instance a telegram was transmitted to Scranton and a reply received within fifteen minutes while the train was still some 20 miles out. In spite of the value of this service, the radio is felt to be more directly applicable to the transaction of railroad business between fixed points during sleet storms or other periods of wire trouble, and with this in view the Lackawanna is planning further installations along its lines. Other railroads are becoming more definitely interested than in the past and are considering the use of radio for emergencies. It may be, however, that the Delaware, Lackawanna & Western, which had the first complete telephone train-dispatching equipment, will also be the first to erect a comprehensive radio break-down service.

Extending Generating Station to Increase Capacity

An interesting bit of engineering history centers around the recent completion of an extension to the steam generating station of the San Joaquin Light & Power Company, at Bakersfield, Cal.

The main plant at Bakersfield was built in 1910 to provide temporary relief for the overtaxed hydroelectric station of the company on the Kern River about 15 miles distant and also with the idea of furnishing eventually a reserve source of electrical energy to supplement the hydroelectric sources then in operation and planned for the future.

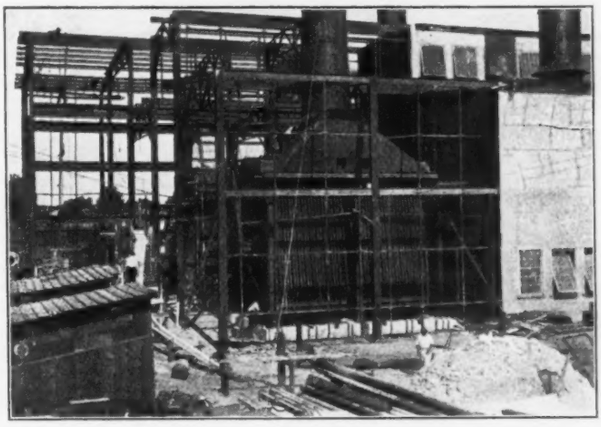


FIG. 1—EXTENSION TO BAKERSFIELD STEAM PLANT

The contract for building this main steam plant was given to J. G. White & Company, and ground for the station was broken on Aug. 26, 1910. On Sept. 28 boilers were received and the temporary turbine arrived three days later. Operation began on Nov. 18, exactly eighty-four days after work was started.

In order to carry out the plan for immediate relief the steam plant was placed in operation before the steel for the building had been received, and for a time the structure presented the very unusual spectacle shown in Fig. 2 of an outdoor steam generating station. During this interval the boilers were entirely without shelter and the turbine was covered only by a temporary shed to protect it from injury from rain or building operations.

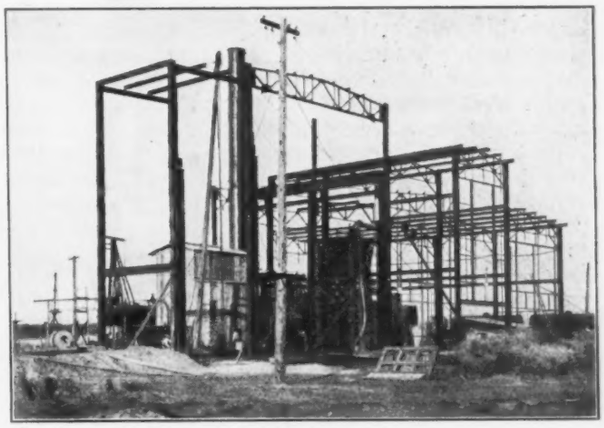


FIG. 2—STEAM PLANT OPERATING BEFORE HOUSING WAS COMPLETED

At the close of 1911 the rating of the main station was 9000 kva, representing the aggregate of two units of 2500 kva and 6500 kva respectively.

Early in 1913, after two seasons of light rainfall, and in view of the rapid growth of the demand for electrical energy in the territory served by this plant, it became evident that additional generating capacity could be advantageously provided, and on April 1 an order was placed for a third unit of 7800-kva rating. Four additional boilers of 604-hp rating, together with transformers and other auxiliary equipment, were purchased, and the plant was completed and put into operation in the latter part of October. The extension of 60 ft. on the turbine room and 40 ft. on the boiler room which it was necessary to build in order to accommodate the extra equipment is shown partially completed in Fig. 1. The work described was done by J. G. White & Company, New York City.

Leonard Patents on Compound Motor Starters

A large proportion of present-day motor starters are what are known as "compound motor starters," that is, a type in which there is combined in one mechanism a motor starter with "no voltage" release and also a resistance for weakening the shunt field and operating at any desired higher speed. About ten years ago it was the general practice in motor starters to have armature control alone and to have the "no voltage" magnet in the shunt-field circuit. But in modern practice it is customary to employ both armature control and field control, so arranged that the two controls are "fool-proof," that is, must necessarily be employed in their proper order. Furthermore, in modern practice the "no voltage" magnet is in parallel with the shunt-field winding instead of being in series with it, so that the wide variation in the shunt-field current for purposes of speed control will not affect the reliable performance of the "no voltage" magnet.

On Nov. 4, 1913, three patents, Nos. 1,077,613, 1,077,-

614 and 1,077,615, broadly covering the automatic features of compound starters, were issued to Mr. H. Ward Leonard. In the specification of each of these patents occurs the following outline of the requirements of a satisfactory starter:

"The controlling apparatus for such motors should have the following characteristics: First, an overload protective device which will positively and with sufficient promptness open the circuit to the motor if under any conditions of starting or operation a current greater than a certain predetermined amount should flow in the motor circuit. Second, this overload device must be such that the motor can be safely and simply started up again by the operator without loss of time and without expense. Third, a 'no voltage release' or electro-responsive device which will automatically act if the supply voltage fails, or is reduced to a very low point, to protect the motor against the risks due to a sudden rise to full voltage, and such 'no voltage' device shall be dependent upon the volts upon the motor armature and shall be independent of any current through the motor. Fourth, a device by the manipulation of which the operator can readily change the speed of the motor gradually and over a wide range, so that, for example, a cutting tool can be worked in the most efficient manner at any speed and cut within the capacity of the motor. Fifth, a starting rheostat. Sixth, interlocking or functionally related mechanism, or equivalent arrangement of mechanism, which will insure the proper sequence of adjustments, and whereby it will be impossible for the operator to start the motor while the motor has an improperly weakened field. While this interlocking or equivalent mechanism is preferably arranged directly between the speed-controlling device and the motor starter, it is evident that it may be applied between any device controlling the speed controller and any device which controls the current passing through the motor armature, such as a switch in series with the motor armature and starter."

The first patent, No. 1,077,613, contains forty-three claims. The invention seems to be indicated fairly well by Claim 37, which reads as follows:

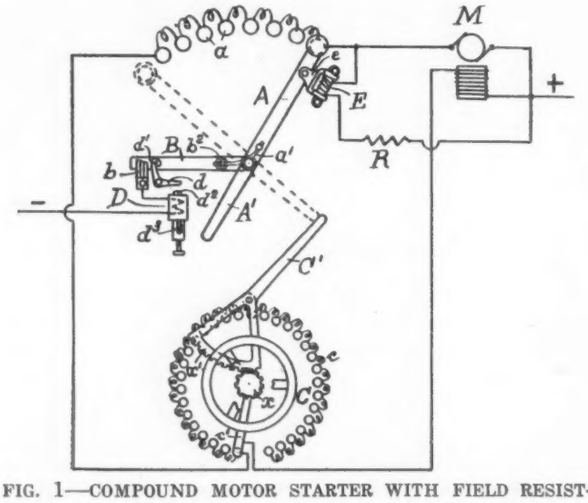


FIG. 1—COMPOUND MOTOR STARTER WITH FIELD RESISTANCE AUTOMATICALLY CUT IN WHEN "NO VOLTAGE" OCCURS

"The combination of a constant electromotive force supply circuit, a motor connected therewith and having a field winding energized independently of its armature current, controlling means for said motor comprising two operatively, protectively mutually related resistance-controlling movable members, one of said members being adapted to control the circuit of the motor armature, and the other of said members being adapted to control the said motor field winding, and protective means comprising a 'no voltage' winding energized independently of the currents in said armature and said field winding, insuring that the field-controlling resistance will be sufficiently low in value when the starting current is passed through the motor armature."

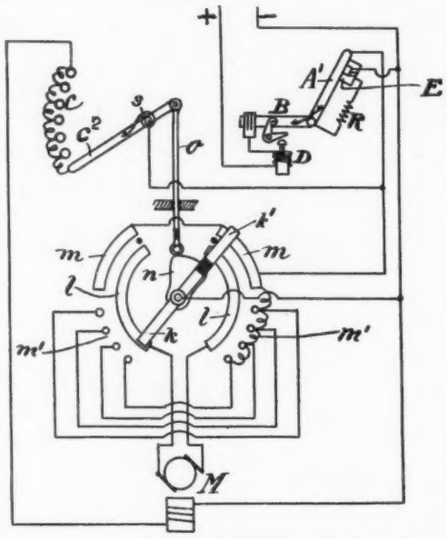


FIG. 2—COMPOUND REVERSING MOTOR STARTER

The second patent, No. 1,077,614, relates especially to controllers for reversible motors, and a typical claim (Claim 29) reads as follows:

"The combination of an electric motor, means for varying and reversing the current through one element of said motor and for varying the current in the other element of the motor, and an automatic controlling switch the closure of which is controlled by said means."

The third patent, No. 1,077,615, relates to the forms of compound motor starters in which the entire manipulation in practice is done by a single handle. Claim 27 of this patent reads as follows:

"A controlling device for an electric motor comprising starting and speed-regulating mechanism, a 'no voltage' magnet, and a common operating means arranged to start the motor, regulate its speed and bring the starting mechanism under the influence of the 'no voltage' magnet."

Mr. Leonard's applications were filed on July 11, 1903, or more than ten years before the final issue. A long interference took place between Leonard and Horton, the latter associated with the Cutler-Hammer Manufacturing Company, over Claims 19, 21, 22, 26 and 27 of patent No. 1,077,613, which the office had inadvertently granted to the latter, although his date of conception was subsequent to Leonard's filing date.

The final decision in the matter of this patent was handed down by the United States Circuit Court of appeals. Claim No. 26 will serve to illustrate the five claims that were the subject of litigation. It is as follows:

"Claim 26. In combination, a movable member, a resistance controlled thereby, a second movable member, a resistance controlled thereby, means for connecting said members to cause the same to move in one direction together but permitting said first movable member to move in an opposite direction independently of the second member, and means for automatically returning both members to their initial position upon the release of said second member."

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

Central-Station Float on Electric Truck, Menominee, Mich.

A pageant in which the merchants of the twin cities of Marinette (Wis.) and Menominee (Mich.) some time ago participated happened to be held at an opportune moment for the Menominee & Marinette Light & Traction Company to enter its new electric truck in the procession and advantage was also taken of the event to display appliances from the company's electric shop. A motor-driven washing machine and a general-utility motor shared the center of the truck with a gas-range, while the sides of the vehicle were decorated with electric irons and the front and rear carried electric-fan displays. The float was easily one of the most attractive in the parade, and with the public-spirited proclamations on the banners at the sides there can be

CENTRAL-STATION FLOAT

little doubt of the favorable impression it created in the minds of the citizens.

Low Wiring Prices Boost Electric Service at Lima, Ohio

During the fall season an average of 165 houses a month at Lima, Ohio, were equipped for electric service. Mr. J. C. Sweeney, superintendent of the lighting department of the Ohio Electric Company, which operates electric railways and supplies energy for lighting and motor service in western Ohio, attributes this extraordinary increase in business to the reduced wiring prices being offered by local contractors. Although Lima has a population of but 30,000, between twenty-five and thirty wiremen are at work on house-wiring jobs at all times. Keen competition between the contractors has forced wiring prices down until in some cases work is done at prices ranging from 40 cents to 50 cents an outlet.

General realization of the advantages of electricity over gas by the inhabitants of this former natural-gas belt has also been a possible factor in the record-breaking wiring business being done at Lima.

Stimulating Electric-Vehicle Interest in New England

To increase interest in the electric vehicle among prospective users in the outer Boston district a meeting of the New England Section of the Electric Vehicle Association of America will be held at Salem, Mass., on Jan. 15. The program includes a parade of electric trucks and pleasure cars at 3 p. m. through Salem, Beverly and Peabody, a dinner at 6 p. m. at the Salem Club, an illuminated vehicle parade through the Salem business district at 7:30 p. m., and a meeting in Board of Trade Hall at 8 p. m.

The speakers will be Mr. H. F. Thomson, of the research department of the Massachusetts Institute of Technology; Mr. Frank J. Stone, of the Electric Storage Battery Company; Mr. George W. Holden, of the Edison Storage Battery Company, and representative electric-vehicle dealers. The Salem Electric Lighting Company is inviting visitors to its plant on this date and is offering free energy and garaging to all out-of-town cars associated with the gathering. Mr. J. A. Hunnewell, of Lowell, Mass., is chairman of the New England Section, and the business secretary is Mr. O. G. Draper, 39 Boylston Street, Boston.

Acquiring Ice-Making Load at Reading, Pa.

Officials of the Merchants' Ice Company, of Reading, Pa., after spending a number of months investigating different methods of plant drive and visiting some of the most modern electrically operated ice factories in the country, have contracted with the Metropolitan Electric Company, of Reading, Pa., to buy central-station energy.

At the present time the ice company has two 40-ton York steam-driven ice machines installed, but since during the past summer its business outgrew its product a new 100-ton machine has been decided upon. The local central station decided to go after this business and arranged to have representatives of the ice company make several trips to different ice plants using electric drive, among them the Knickerbocker Ice Company, Chicago, Ill.; the Webster City Ice Company, Buffalo, N. Y., and others. The result is that not only will the new equipment be driven electrically, but the two steam machines will in the near future be changed to electric drive also.

One 300-hp motor will drive the 100-ton machine and two 125-hp motors will operate the 40-ton ammonia compressors. A 20-hp motor will drive the air compressor for pumping condensing water. Several smaller motors are to be used on the brine agitators and other accessories. Other apparatus which will be installed with the new equipment includes a twelve-

effect distiller, built by the York Manufacturing Company, and a We-Fu-Go & Scale Company water purifier. The latter machine is to be used to soften and purify the condensing water before it goes to the distiller. The condensing water continues uniformly throughout the year at 54 deg. Fahr., and the ice company expects to manufacture a ton of ice for 42 kw-hr.

Reaching the Small Towns in Central Illinois

Size, or the lack of it, is apparently no bar to the small community's receiving service from the Illinois Northern Utilities Company, whose cross-country transmission lines now extend over a large section of the northwestern part of the State.

Among the towns which have recently contracted for service with the company is Kingston, Ill., with a population of 300. The initial order placed with Mr. C. B. Yonts, general contract agent, called for the installation of twenty-two street lamps, or one for every street corner in the village. Contracts have also been closed for the operation of an electric motor to pump the village water supply. The local citizens are greatly pleased at the step forward thus taken, and they declare that the electricity for street lighting will cost less than even the kerosene formerly consumed, while the motor-driven water-works will show a yearly saving over the gasoline fuel formerly required for the pumping engine. The street-lighting contract represents an annual income of $2 per capita of population, while the pumping service will add another dollar per capita to the central-station income.

The commercial department of the company is on an average wiring one house to every eight inhabitants of the communities it reaches, these customers' contracts being practically all signed before the transmission lines are complete. After service is available in the towns it is expected that the number of customers per capita will be even further increased.

Instilling Courtesy Into Company Subordinates

It can be set down as a truism that a satisfied customer is the best advertisement for any company, said Mr. E. R. Kelsey, advertising manager of the Toledo (Ohio) Railways & Light Company, before a meeting of the Association of Ohio Properties operated by Henry L. Doherty & Company, held recently at Toledo.

Of what use is a high-salaried advertising man if the company has a $5-a-week boy at its application desk?

One short, ill-tempered reply from a telephone operator or from a boy selling lamps can quickly break down all the selling arguments of the company's best salesmen.

The new-business manager may be known personally to comparatively few customers; the president himself cannot hope to meet as many as he would like; but the clerks, meter readers and lamp boys are all meeting customers every day. The company will be judged by the treatment given to its patrons by each employee.

Many companies hold regular meetings of heads of departments to talk over public policy plans—how best to meet and please patrons. Excellent indeed are the results accomplished, and yet how few meetings there are with the telephone operators, the meter readers, the clerks behind the application desk and other subordinate employees, who have it in their power either to make or break the company's friendships.

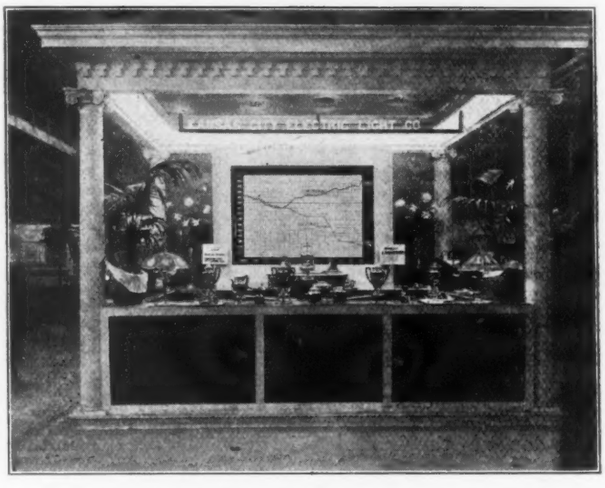
In each office, advised Mr. Kelsey, there should be some one man, skilled in diplomacy and in the knowledge that "a soft answer turneth away wrath," to handle the complaints. It is not the treatment their complaints receive that counts half so much with some people as the treatment given their pride. A battle is always lost when an adversary loses his temper. Every consumer has the right to courteous treatment, and the right man handling complaints can easily turn into friendship for the company the spirit that formerly represented antagonism.

"Is it easy to get to your complaint department?" asked Mr. Kelsey of the managers present, "and is the person complaining made to feel that he is doing the company a favor? And after a complaint of a new installation is made does someone telephone or make a personal visit to see if the company's service is satisfactory? A little thing, you may say, but to the consumer it is an evidence that the company is taking a personal interest in him.

"Never neglect to investigate a complaint. You may receive a valuable suggestion. You may find a defect that needs remedying. With so many consumers you cannot hope for satisfactory service unless you make it plain to your customer that he must co-operate with you. In that way he feels that he has a real interest in the company and the company has a real interest in him beyond the mere payment of a bill."

A Central-Station Display Booth at Kansas City

From the standpoint of the Kansas City Electric Light Company, the manufacturers' exposition held in



COVE LIGHTING IN CENTRAL-STATION BOOTH

that city in December was a conspicuous success. This exhibit of "Made in Kansas City" goods was held under the direction of the local commercial club, and various manufacturers installed practical machines and turned out their products just as in their own shops or factories.

From a lighting standpoint the central-station company's booth differed radically from others in the hall. A cove system was employed in which the new 12-in. tubular tungsten lamps were utilized with gratifying results. Used in this way, forty-two 40-watt lamps, representing an expenditure of about 5.1 watts per sq. ft., produced a soft, glareless illumination of comparatively high intensity, which aroused considerable interest and drew forth much favorable comment. The accompanying photograph, which was made with a two-minute exposure on an ordinary plate, shows the even

distribution of light afforded, and there is a wealth of detail in the picture which would probably have been impossible of attainment without the aid of a flashlight under any other system of electric lighting. One of the new high-efficiency tungsten lamps was also exhibited and attracted considerable attention.

The curve showing "Cost of Living Compared with Electric Lighting," which occupies the central position in the picture, was painted on a piece of curtain cloth 4 ft. 6 in. by 6 ft. 6 in., which was placed in a box and illuminated from the back in such a manner as to eliminate all spots or shadows. It served to furnish food for thought for any disgruntled individual customers who might think that electric light is unduly expensive.

A complete line of electrically heated devices and cooking appliances was shown and demonstrated. The public evidenced its appreciation by consuming 125 lb. of toasted marshmallows prepared on an electric grill. Although the actual sales at the show were comparatively small, the interest aroused resulted in bringing a steady stream of customers to the display rooms and in the sale of a considerable number of energy-consuming devices.

Emergency Assembly Test on Boston Edison System

Responding at top speed to the emergency call "Serious trouble at L Street," more than 100 officials of the Boston Edison company assembled at the system's main generating plant in the small hours of a recent December morning to find awaiting them a sandwich and coffee luncheon instead of realizing the visions of burning coal fields, exploded boilers and wrecked turbines which sprang into being with the telephone summons sent forth to each man's home on the stroke of twelve.

The test was planned by General Superintendent W. H. Atkins without giving the slightest inkling of it in advance. At the call, the men on the emergency list from all over the system pressed every possible agency into service to reach the station. Automobiles, taxicabs, hacks, carry-alls, night cars on the Boston Elevated system and in some cases pairs of stout legs were called upon, and even the members of employees' families co-operated in making the "get-away" a success.

Records of the time of calling each man and the time of his arrival at L Street were kept, and many valuable points were ascertained which will be of use if a genuine emergency arises in the future. Within thirty-seven minutes each one of the forty-five men whose names are on the regular emergency list had been called up. The test was not only a call to the L Street station, but for many subordinate employees it was a call to report at their headquarters for unknown duties. Emergency men presented themselves at the company's garage, stockrooms and district offices, and in many cases it was necessary to use toll lines and messenger service in reaching the men wanted. District foremen in charge of lines, chauffeurs, construction crews and other employees made record time to their quarters. The heads of departments in many cases utilized the time while waiting for the arrival of automobiles in telephoning to subordinates and concentrating their forces at headquarters, pending further instructions.

The table gives the relation between arrival time and distances from the L Street plant.

Individual times of response varied from four minutes, in the case of an electrical engineer living about 100 yd. from the station, to one hour and nineteen minutes for an official whose home was 16 miles away and who made the trip in a local taxicab.

Among the points brought out which indicated possible improvements in handling emergency calls were the desirability of turning on porch lamps or front-room lamps when waiting for chauffeurs at residences, in order to save time in picking up officials; the maintenance of correct address lists and index cards giving shortest routes at company automobile service stations;

DATA ON EMERGENCY TEST, BOSTON EDISON COMPANY

Time of Arrival	Average Distance, Miles	Average Time, Minutes
12:11–12:30 A.M.	3.00	17
12:30–1 A.M.	3.75	34
1–1:30 A.M.	4.50	45
1:30–1:52 A.M.	9.00	67

superiority of long rings on the telephone compared with short calls when waking persons wanted in emergencies, and the need of more complete arrangements with local contractors for handling emergency night service. The installation of a telephone in the home of one member of the main stockroom crew was also suggested as a means of more quickly getting the force together.

In appreciation of the loyalty and reliability of the staff in responding to this unexpected demand upon its "readiness-to-serve," Mr. Atkins contributed a letter to the current issue of *Edison Life*, in which a detailed account of the emergency drill is printed, with cartoons of prominent employees and extracts from their personal diaries.

Boosting Heating Appliances Through Women's Literary Clubs

The business management of the Union City (Ind.) Electric Company recently furthered the popularity of electric heating devices in Union City by getting one of the ladies of a prominent local women's club to read a paper entitled "Electrical Conveniences for the Home" at one of the club's regular afternoon meetings.

A day was set aside in advance and the paper duly presented before the club members, about thirty in number. It gave a clear and interesting description of the practical uses to which various appliances might be put, particular emphasis being laid on the great saving in labor for the housewife. The subject was rendered still more impressive to all present through the co-operation given by the hostess of the club in serving an afternoon luncheon to the ladies which had been prepared wholly by electrical appliances on the dining-room table.

A percolator, a toaster, a chafing dish and a grill were operated simultaneously. The electric company also helped by sending to the home a supply of all kinds of appliances. These were arranged attractively in the rooms where they would come to the attention of the club members.

Orders for several appliances to be used as Christmas presents were secured directly in this manner. Indirectly, also, the event came to the attention of many persons of the town not members of the club, and the propaganda of electrical appliances was thus spread wide. This publicity proved particularly valuable since it was of the mouth-to-mouth kind and came through neighbors and friends, rather than directly from the electric company.

The Union City Electric Company was recently acquired by the Albert Emmanuel syndicate, of Dayton, Ohio. Mr. D. O. Vaughn is local manager.

The Committee Idea in the Sales Division

A committee system has been inaugurated in the sales department of the Rochester Railway & Light Company for the purpose of conserving and tabulating the knowledge and experience gained by each salesman and disseminating this information among his fellow-workmen. Committees are assigned to each of the following topics: Data book, new applications of electrical energy, steam distribution and sales, illumination and lamps, refrigeration, private plants, motor installations and mechanical drives, consumers' transformers, protective and meter installations, electric heating, contractors' equipment, electric vehicles and garages, rates and the use of electricity on the farm.

Meetings are held once a week at which one or two of the committees report. The reports are discussed and if approved are placed on file. The file is indexed so that all the information obtained is immediately available. A committee is assigned the task of editing and condensing these reports, which are then ready to be incorporated into a data book. This book, when completed, will also contain references to interesting installations, statistical data pertaining to the company, and copies of complimentary letters. One of these books will be given to each member of the staff, who will then have evidence in hand to verify his arguments.

Harvesting Ice with Central-Station Energy

The Central Massachusetts Electric Company, of Palmer, Mass., is making effective use of electricity in harvesting ice by the methods shown in the accompanying illustrations. Last winter the outfit seen in Fig. 1 was employed by a local ice company, the installation having been made under the conditions that the consumer should pay the regular rate of 8 cents per kw-hr., without discount, and in addition should meet the cost of running service wires into the premises and of dismantling the wires and truck rigging. The net cost of the rigging on the truck to the ice company was $20, the central station having made the installation of a temporary character so that a good deal of the equipment could be used in other ways later. The ice equipment was collected and installed on the truck over night. It consists of a three-phase, 220-volt induction motor, countershaft, two transformers, meter and switching device. At two of the company's ice houses this equipment superseded the service of a portable engine and boiler which operated a drum hoist. In making the application the connecting rod of the engine was unbolted from the crank shaft and the flywheel was belted directly to the motor-driven countershaft on the truck. The rest of the hoisting mechanism remained unchanged.

The success of this apparatus last year led to its purchase by the ice company, and this winter it will be maintained as a part of the regular ice-cutting equipment. The Blackstone (Mass.) Electric Company, also one of the Parker properties, has just obtained a contract from the Miller Ice Company, in East Blackstone, for the installation of a 20-hp motor, for which service the consumer will pay the regular rate of 10 cents per kw-hr. and purchase the entire equipment. For the service at Palmer a 20-hp motor was used last year, but this was found to be too large, as shown by the accompanying tests and cost data.

Although the total revenue was small for this service, the use of electricity in harvesting ice proved to be a great advertisement for the company throughout its entire territory and aroused great interest.

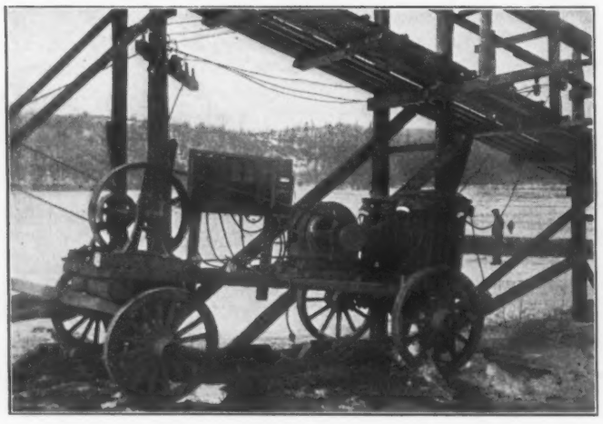


FIG. 1—ELECTRICAL EQUIPMENT FOR HARVESTING ICE

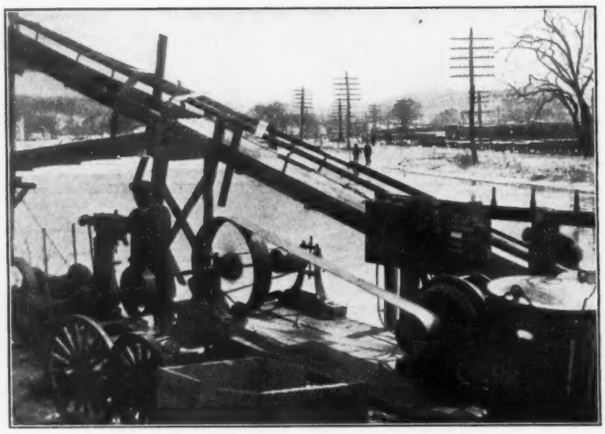


FIG. 2—INCLINE FOR CONVEYING ICE

DATA ON ICE HARVESTING BY ELECTRICITY, PALMER, MASS.

Speed of ice travel, feet per minute	85
Shaft load, hp	3.7
Load and 1400 lb. ice, hp	6.1
Net per 200-lb. cake, hp	0.33
Maximum cakes on ice way, number	14
Maximum power, fourteen cakes on way, hp	8.5
Total ice harvested, tons	1031
Total kilowatt-hours used in harvesting	95
Total cost of harvesting, energy	$7.60
Cost of energy for harvesting, per ton	0.0076

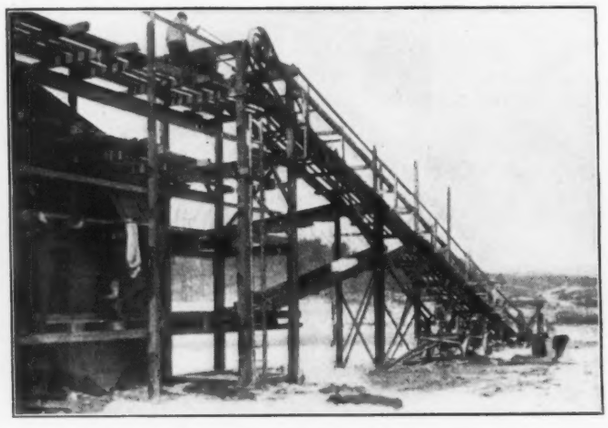


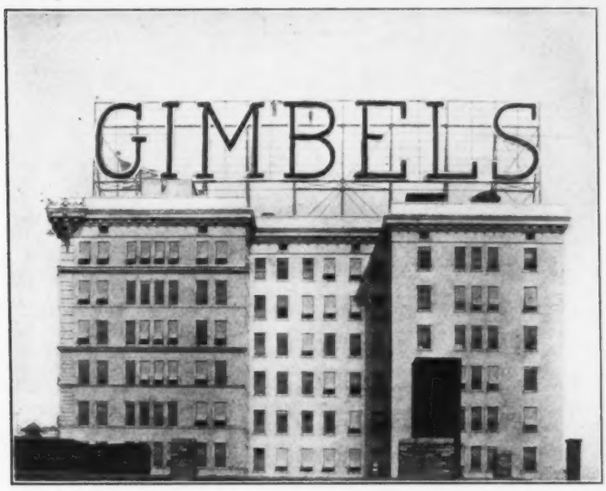
FIG. 3—HARVESTING ICE BY DRIVE FROM BELOW

Illumination and Wiring

A Giant Single-Word Electric Sign at Milwaukee

An electric sign declared to be the largest single-word electric roof display in the world is in operation on the Majestic Building, Milwaukee, where it advertises Gimbel Brothers' department store. The sign formerly erected in this position was destroyed by a severe storm, and to guard against a similar accident twenty concrete piers measuring 2 ft. by 2 ft. have been laid in the roof as sleepers for the 8-in. by 14-in. double angle irons used as the vertical and horizontal supports. The figures of the men in the accompanying illustration give some idea of the size of the display.

The sign is lighted by 1500 10-watt tungsten lamps supplied from the circuits of the Commonwealth Power Company. The letters are 32 ft. high, and the entire sign measures 159 ft. long and 52 ft. high. The size



GIANT ELECTRIC SIGN

of the individual letters makes it possible for the sign to be read at a distance of 15 miles on a clear night.

Educating the Public in Good Lighting Practice

At the International Exposition of Safety and Sanitation held recently in New York the Illuminating Engineering Society had an interesting educational exhibit which consisted of a series of small booths illustrating correct and incorrect methods of lighting interiors. After the exposition closed the exhibit was removed to the American Museum of Safety, 29 West Thirty-ninth Street, New York, where it is now on display. A general view of the booths as they appeared in the safety exhibit is shown in Fig. 1.

One booth, designated as No. 3, contained a placard made up half with a glazed surface and half with a matte surface like that of blotting paper. The card was oscillated automatically, and at certain angles a letter printed on the glazed surface became invisible owing to specular reflection, although the letter on the matte surface could always be seen. The purpose of this booth was to show the effect of glare from shiny or glazed paper on the eye's ability to see, and to suggest how the eyesight can be preserved by having books and magazines printed on unglazed paper.

Booth No. 4 consisted of a miniature schoolroom equipped with glossy-surfaced and dull-surfaced blackboards. Several kinds of natural and artificial lighting were shown, which were made to change periodically. For reading it was shown that light should come from the side or rear in such a direction as to avoid glare in the eyes and shadows on the book. The effects with the glossy-surfaced blackboard were similar to those obtained with the glazed paper. Viewed at

FIG. 1—BOOTHS SHOWING CORRECT AND INCORRECT LIGHTING SYSTEMS

certain angles, the letters were entirely invisible. The dull-surfaced boards were more comfortable for the eyes, and the chalk inscriptions on them could be read with ease.

The next booth illustrated correct and incorrect methods of lighting show windows. In the former the light sources were hidden by a reflector, which directed the light from in front and downward over the display, thus illuminating the goods at a high intensity and at the same time protecting the eyes of the observer. With the incorrect method, exposed light sources were used to line the windows, partially "blinding" the observer and preventing him from seeing the goods advantageously.

Booths Nos. 6 and 7, shown in Fig. 2, illustrated correct and incorrect methods of machine-shop lighting,

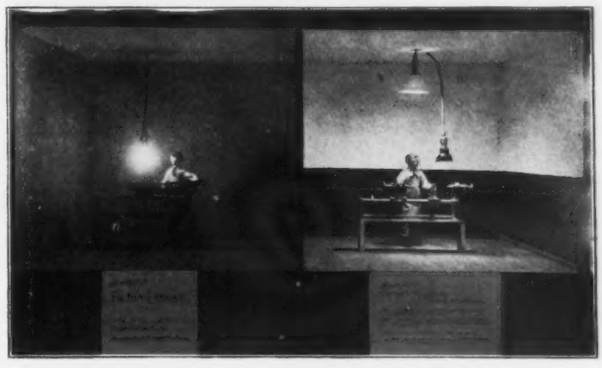


FIG. 2—INCORRECT AND CORRECT METHODS OF MACHINE LIGHTING

suggesting also how proper illumination will prevent accident. Both localized and general lighting were successively applied in booth No. 6 and the lamps were equipped with reflectors. These reflectors distributed their light economically in the useful direction, at the same time keeping the rays away from the workman's eyes. The units were so located as to give the highest

intensity on the more important parts of the machines and to eliminate objectionable shadows. The room was finished in a light color, adding to the economy of illumination. The lamp in booth No. 7, as shown in the illustration, had no reflector. A bright light shining before the eyes of the workman would naturally be a hindrance to efficient production and would increase the liability to accidents. The lamp was also placed improperly, the important parts of the machine being in shadow. The dark surfaces tended to reduce the quality of illumination.

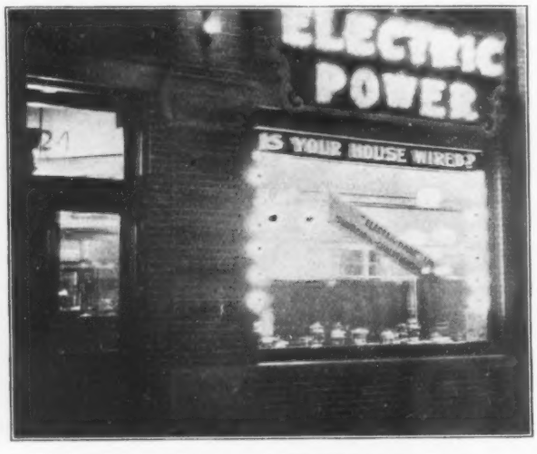
Booth No. 8 showed the four following methods of lighting rooms: (a) bare lamps giving glare; (b) lamp with opal reflector, an example of direct lighting; (c) lamp with semi-indirect inverted reflector projecting the major portion of its light onto the ceiling for redistribution; (d) lamp inclosed in opaque indirect reflector, all light being thrown on the ceiling and upper wall for redistribution.

In booth No. 9 light was thrown on a statue in succession from above, from the right, from below and from the left, and finally a more diffused illumination was thrown on the model from above. This exhibit showed how the appearance of statuary and architectural forms can be affected by the position of the light sources.

Modern New-Business Methods, Menominee, Mich.

The Menominee & Marinette Light & Traction Company, operating electric-service, street railway and gas properties in the northern peninsula of Michigan, finds time to keep its window displays up to date, even though Menominee is not a large city. The illustration herewith shows the lighted window a few weeks before Christmas, percolators, samovars, irons, water heaters, luminous radiators, general-utility motors and the like occupying prominent places under the conspicuous sign advising the purchase of electric ware for Christmas gifts.

Taking advantage of its opportunity, the electric-service company has established in one building its

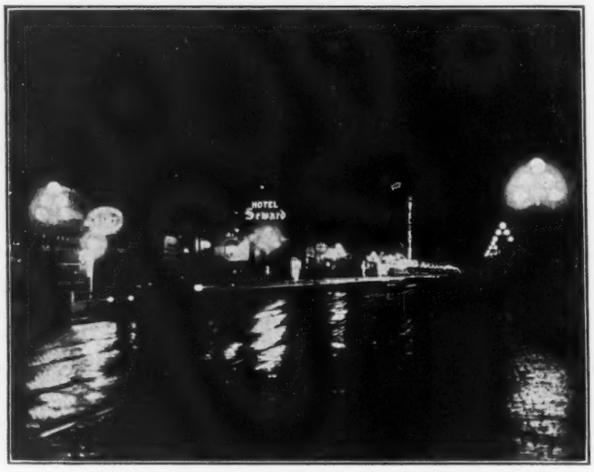


WINDOW DISPLAY AT MENOMINEE, MICH.

offices for handling electric-light and motor-service bills, its street-railway and gas business and has arranged the electrical displays where they will be before the eyes of all callers. Among the other up-to-date new-business methods employed by the Menominee Company, a bulletin of vacant wired houses is maintained corrected in this office. During the past year a remarkable record for connecting small customers has been made, for within the two towns of Menominee and Marinette, totaling 25,000 in population, an average of more than one service per working day has been added to the company's circuits.

Nitrogen-Filled Tungsten Lamps in Seattle's Ornamental System

The first nitrogen-filled tungsten lamps to be used for ornamental street lighting are now in operation in



NITROGEN-FILLED TUNGSTEN LAMPS IN SEATTLE STREET LIGHTING

Seattle, Wash., and have attracted much attention locally by reason of their great brilliancy and pure-white color. These new nitrogen-filled lamps are of the 80-cp, 6.6-amp type, the first to be made commercially available, and the lot shipped to Seattle constituted the initial assignment sent out from the factories of the National Quality Division of the General Electric Company.

The poles equipped with the new units are standard five-lamp posts having their lamps fed from individual 250-watt transformers in each pole base. These transformers take energy from the 120-volt mains and deliver it at 8 volts to the lamps. Mr. J. D. Ross, superintendent of Seattle's municipal lighting department, equipped these poles with the 8-volt transformers in 1909 when the multiple-type low-voltage tungsten lamp was still in the laboratory, believing that the sturdy filament possible with the low-voltage lamp would give it a length of life well warranting the extra transformation. Proof of the soundness of that early view is at hand in the shape of two of the original tungsten lamps placed in service on the cluster-lamp poles in 1910 and just removed after burning over 12,000 hours. These old lamps were taken down to make room for the new nitrogen-filled units, but the veteran lamps are still unblackened and apparently as good as new. The average life of the low-voltage tungsten units in service on Seattle's municipal street-lighting system—some 11,700 lamps in all—has for the last two years been well over 4000 hours.

When tungsten lamps first became available they were used to replace all the carbon street lamps in Seattle as rapidly as possible. Now it is expected to replace all the old-type tungsten lamps with the new nitrogen-filled units, thus securing even greater economy and better light, and maintaining the citizens' assertion that Seattle is "America's best-lighted city."

Letter to the Editors

Electric Service, Energy and Charges

To the Editors of the Electrical World:

SIRS:—Articles appear from time to time with some such title as "Rates for Electricity." If electricity were something tangible like potatoes or bricks, our natural thought then would be that the cost or price of electricity would be the natural subject rather than "rate." A rate is a measure of movement or motion. We speak of the rate of flow of a river or the rate of doing work, and the term in itself implies differentiation. Why, then, do we use the word "rate"? It is because we properly recognize the continuity of the electrical service. A far better general title would be "rates and prices for service and electricity."

Community development is the measure of civilization. Money is the universal medium of barter. In the effort to establish the common law for barter the intellect of man has during many centuries gradually evolved two quite different general classifications of exchange in which this common medium is used.

First—The sale and purchase of something the vender has in excess of his own needs in which the price paid is always less than the value to the purchaser. One who has an excess of a thing beyond his needs will sell such a thing at the best price he can get without regard to its cost to him.

Second—The second class of exchange represents that development of the community idea which, as I have said before, is a measure of the progress of civilization and by which an individual contributes his proportion to the expenses of the community. Inasmuch as this payment is involuntary, being dictated by the community and being measured not by the value to the payee as an individual as may be determined by himself but as determined by the community, this second class of demand has received a definite name and is called taxes. The theory of taxation is in a state of development and doubtless is still a long way from being exactly equitable.

Electric central-station service is a distinctly modern development. Its charges have much in common with the charges made by other public utility companies, such as transportation and water companies, etc. The charges by these quasi-public corporations lie somewhere between the first and the second classes. Inasmuch as electric service is in a measure competitive and inasmuch as it is in competition with an inferior but somewhat approximate service which can be rendered by the customer to himself, it is obvious that no central-station service can be rendered at a greater price than the recipient is willing to pay. For the same reason the community has no right to demand that charges for this service shall be based entirely upon the cost to the public utility company unless the community also properly controls such competition, thereby placing the question of charges for electrical service clearly in the second classification, that of taxes.

Inasmuch as the community in this democratic country of ours is, in the final analysis, supreme, when the time comes for the community to use electric central-station service exclusively, carrying to its logical conclusion the universal decision of commissions and courts to the effect that central-station service is a natural monopoly, then the basic equity of charges from the standpoint of taxes will receive consideration. The water companies have for a very long time been in this class.

It is generally conceded that the commonwealth has the right to demand that public service corporations to which exclusive franchises have been granted shall not derive more than a reasonable return upon the capital used and useful in performing their public services. We should not confuse this qualification, applying to the business as a whole, with the question of rate schedules, which apply to classes of consumers. Moreover, courts and commissions have allowed public service corporations, provided that there is no discrimination between customers demanding service under equivalent conditions, fairly wide latitude in establishing charges for their services in order that they may best utilize their capital.

The gas rates are usually much less equitable than the electric rates. Of course, this has resulted from the fact that the gas industry is older and that it was born at a time when rate theories were far from being as developed as they are to-day. The subject is further complicated by the fact that the gas can be transmitted in closed vessels and has the form of a commodity. Instantaneous service of any sort was not a recognized condition of any industry previous to the days of the water and gas companies, and as water and gas can be stored the fact that these can be delivered to the premises of the consumers did not in the public mind seem equivalent to delivery, nor were the expenses incident to such delivery fully appreciated by the consumers for many years.

The telephone and electric-light companies, which must give instantaneous service and which do not deal in anything recognizable as a commodity, by which I mean something that can be stored in vessels or carried in bulk from place to place, are the first general cases of their class.

It was not until the advent of these two companies that the theories of charges for service began to be developed or used. Were the gas and water companies to start over again, their forms of rates would be quite different from what they now are.

The fact that two electric companies have not really the same schedule is a mark of progress and evolution from the condition of the gas-company rates into a more scientific rate of charging, and the time is coming when the gas companies themselves will be forced to an abandonment of their elementary system of charges.

The divergence between the system of charges used by the more progressive central stations which are free from demagogical interference on the part of purely local public authorities appears greater than it actually is. A scrutiny of the 1911 report of the rate research committee of the N. E. L. A., particularly that portion referring to the three-dimensioned rate models, makes this particularly clear.

One recent writer stated that the difference between the highest and lowest rates is almost incredible, quite ignoring the fact that the rates per kilowatt-hour appearing in the usual rate schedule are merely the charges for service plus the charges for energy, divided by the number of kilowatt-hours supplied. They are not charges for electrical energy alone, but include also not only the cost of delivery of the energy supplied but also the cost incurred in anticipation of instantaneously meeting the customer's maximum demand for energy. The inherent unfairness of such a statement is so evident that there should be no discussion. It is only because of a concession on the part of the central stations that their rates are shown by the kilowatt-hour for the benefit of that part of the public which does not realize the fact that the central stations are rendering primarily a service rather than selling a commodity.

If one wished to be captious, he might instance in practically every charge for service inequalities just as glaring. Take, for instance, street railway fares. The

advocates of the zone system show the glaring inequalities of one man riding 10 miles for 5 cents where another man rides only 1 mile, thereby showing that the rates vary as ten to one for a passenger. They might assume the extreme case of the weight of the individual and consider the charge for a ton mile, for it is evident that a 200-lb. man carried 10 miles and a 50-lb. child carried 1 mile show a disparity not of ten to one but of forty to one! If they would consider the case of "off-peak" and "on-peak" fares, it would become even more obvious that this 200-lb. man carried 10 miles on the peak load is getting his fare at an extremely cheap rate, whereas the 50-lb. child carried 1 mile during "off-peak" raises the disparity in charges from a forty-to-one to perhaps a two hundred-to-one ratio.

That these illustrations are not unfair will be quite evident in the study of foreign street railway fares with their classification of service into first, second and third classes, with their zone systems and with their preponderance of third-class service during certain hours of the day and of high-class service during other hours of the day.

Mr. Percival Robert Moses, in a very recent article in the *Electrical World*, says that the cost to the large central station of a small customer for practically all items comes about the same in terms of the units sold, yet one does not have to go far to show how absolutely impossible such a conclusion is. If he would take the individual cases of the isolated plant demanding breakdown service, he would see that the cost to the central station is almost purely a demand cost. The kilowatt-hours sold would be few, whereas a consumer such as a street railway or a large hotel may spread its use over so large a part of the day that a very considerable part of this cost will be the kilowatt-hour cost. If, on the other hand, we go to the smallest cost of the smallest customer that is handled in many American cities—and a much larger number in European cities—on a very small connected load, it will be found that such customers occasion almost entirely a customer's or consumer's cost, and that the cost for demand or kilowatt-hours is very small.

In Mr. Moses' article Mr. Brandeis is quoted. No one can find any fault with Mr. Brandeis' opinion, as, with the logic of a clear mind, he first states his premises and then his deductions therefrom. Mr. Brandeis says: "Assuming that the cost of producing and delivering electric energy is the same per unit." Such an assumption is without basis in fact, and hence his deductions, though sound, fall as did the Venetian Campanile, not because they are unsound, but because the foundation is faulty.

Mr. Brandeis, as quoted by Mr. Moses, states positively that the central-station charges fall into the second class of charges. This must be recorded as an opinion, since court decisions, commission decisions and present practice differ in this respect in different cases.

A fundamental error is frequently made in assuming that it is discrimination to base the charge in accordance with the use to which energy is put. The real point at issue is that the time of duration of and relative amount of demand for certain classes of trade are so characteristic and differ so much from other characteristic trade requirements that the central stations have chosen to designate the rates therefor by naming the use to which the energy is applied, avoiding thereby a longer and more involved description, which would be generic. These rates consequently are not made for the use, but rather for the time duration and other characteristics of such use.

On the basis of barter, in my first classification of charges, the value of service and its character are both recognized as proper bases for discrimination.

In some of the older professions, such as the medical and the legal, where charges are purely for service and in which nothing approaching a commodity plays any part, those bases are almost universally recognized to-day.

In the second class of charges—or, as they are called, taxes—this point of view also holds to a very considerable extent to-day. Take, for instance, the single illustration of the cost of policing a city, which is a community charge and which is paid out of the general tax fund. No one will hold that the police department spends more time and goes to greater expense to protect one building than another. In fact, money in bank vaults probably demands the least time of protection on the part of the police or fire departments, and yet no special tax allowance is made therefor. We appreciate that the value of this protection is a measure of the proper charges. Without the police department such property would be in danger, but the mere fact of the existence of the police and the community protection the police organization affords protects property in just the same sense that the break-down switch on the premises of an isolated plant protects that plant against loss from a shut-down even though such a shut-down may never occur.

If we might assume Mr. Brandeis to be a single taxer, his point of view would be more easily understood, although even in this case single-tax advocates recognize the value proper in distributing taxation for the protection or service and not alone the cost of such protection or service. No tax expert goes so far as to suggest distributing charges for police or fire service against the man actually robbed or against the property actually on fire.

It must be assumed that as time passes the quasi-public corporations will more nearly adjust their charges from the viewpoint of the taxation expert, probably by classes. This seems to be the trend of commission and court decisions, and the consequent state of apparent chaos is merely an evidence of a change in progress.

The extent of central-station service, as has been stated, is merely a measure of our electrical civilization. We will probably live to see central-station service so universally supplied where isolated plants now are in operation that it will be considered quite as improper for any customer to manufacture his own electricity as it is to manufacture his own gas or to pump his own water. There are many cases in the Middle West where a man could obtain all the gas he needs by driving a well in his own yard, and yet he takes service from the natural-gas companies. The reason is not far to seek. It is based purely on fundamental economics, which in the end will govern.

The cost of central-station service and of electrical energy is extremely difficult to classify, but on general principles we must agree that two adjoining isolated plants can be served from a plant common to them both more cheaply than they can be served separately. What is true of two would be true of more than two. A general statement of this fact is a statement of central-station service. If this be granted, it is quite apparent that the central station should serve isolated plants at a rate somewhat less than they could possibly serve themselves.

It is to be regretted that it is not possible briefly to express the whole rate question. The subject is too involved. Our states have wisely appointed commissions to make the subject a life's study, and to these commissions the central station and the public can wisely submit their differences.

C. E. WENDELL.

Chicago, Ill.

Field of the Operating Engineer

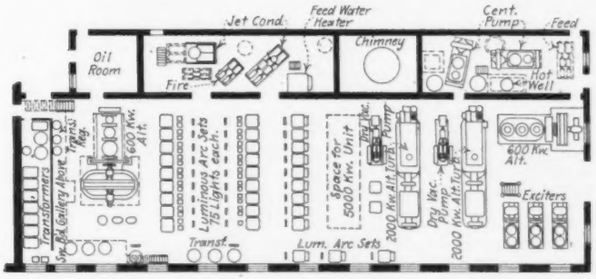
A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

A Winter Warning Concerning Electromagnets

To its electric cranemen handling material with electromagnets during winter weather the safety department of the Inland Steel Company, Indiana Harbor, Ind., has issued instructions to exercise great care in carrying loads over the heads of men on the ground. When the trolley rails are wet or icy contact cannot be depended on to furnish steady power and the load may be accidentally dropped owing to interruption of the circuit.

Utilizing Engine-Room Space to Best Advantage

The municipal street-lighting plant at Detroit, Mich., serves as an excellent example of a station which has been re-equipped without extending the building, to serve a considerably larger system than it was originally intended for. As equipped in the beginning with Western Electric direct-current series-arc machines, the plant soon became limited in the amount of energy it could supply. The old apparatus has therefore been gradually replaced by modern alternating-current generators and mercury-arc rectifiers. Each addition of



ENGINE ROOM IN DETROIT MUNICIPAL PLANT, SHOWING COMPACT ARRANGEMENT

apparatus was made without extending the original building, until now the engine room is literally "packed," although everything is accessible.

This room measures about 75 ft. by 259 ft. and among the apparatus installed in it are the following: Two 600-kw, 2300-volt triple-expansion reciprocating units; two 2000-kw, 2300-volt turbo-generators; three exciters with a total rating of 160 kw, thirty-two mercury-arc rectifiers and regulators (all seventy-five-lamp type except one which is fifty-lamp) and thirty transformers ranging in size from 33 kw to 500 kw, with an aggregate rating of 6000 kw. The method of aranging this apparatus to economize space to the best advantage is shown in the accompanying diagram.

Next spring still another generator is to be installed in this engine room, raising the total generating rating of the station to 10,200 kw. The additional unit will be a 5000-kw, two-phase horizontal-type, double-flow Westinghouse turbo-generator. For use in conjunction with it there will be installed a surface condenser having 8000 sq. ft. of cooling area. Condensing water will be drawn directly from the Detroit River, which flows parallel to the rear of the plant. Records show that the temperature of the river has never exceeded 72 deg. Fahr., so it is expected that a 29-in. vacuum can be maintained continuously on the new turbo-unit. No difficulties will be encountered in conveying the water from the river to the condenser as the maximum variation in the river level is 6 ft. and the normal variation is only 2 ft. The four prime movers which are now installed in the engine room may be connected to either jet or barometric condensers, thereby providing flexible operation.

To make room for additional generating equipment, which may be required in the future, the building will have to be extended toward the river front, unless the reciprocating sets now in use are replaced by turbo-units of higher rating. The present boiler equipment will provide sufficient steam for all apparatus including the new 5000-kw unit, but the commission contemplates also extending and improving the boiler plant in the spring. Mr. Frank R. Mistersky is general superintendent of the Detroit street-lighting system.

Safety Hints for Accident Prevention in Power Plants

To spread practical advice bearing on "the safety idea," the United Gas Improvement Company, Philadelphia, Pa., has just issued a suggestive illustrated booklet on accident prevention, the subject matter of which is an amplified revision of the address of Mr. James B. Douglas, claim agent for the company, before the public-policy meeting at the 1913 Chicago convention of the National Electric Light Association. The following safety hints are reproduced from its pages, together with several of the excellent photographs with which the book is liberally illustrated. These illustrations are copyrighted by the United Gas Improvement Company, Philadelphia, Pa.

Fig. 1 shows a guard rail arranged on a frequency-changer set. This rail prevents employees being caught in moving parts or slipping through the bedplate opening while adjusting brushes, wiping collector rings or feeling bearings. It will also be observed that the step on which the attendant stands furnishes a firm place for his feet, which would otherwise rest on the curved surface of the frame.

Ledges to Prevent Falling Tools

Fig. 2 shows a station operating floor in which the openings around the turbines, stairways and edge of the gallery have been guarded by angle-iron ledges. This comparatively inexpensive precaution has doubtless saved many employees working on the floor below from being injured by falling tools, pipes, bars, etc.

An improved method of carrying ladders on company wagons is shown in Fig. 3, the extension of the ladder being here made to overhang in front of the body instead of at the rear, where it might cause accidents to pedestrians when the truck is turning sharp corners. The safety department recommends that pipes, bars and

all other long objects be carried thus overhanging at the front instead of at the rear.

Fig. 4 shows the use of a wire guard for protecting an exhaust fan. It was feared that an employee standing on the ladder might lose his balance and in attempting to save himself thrust his arm into the fan blades.

FIG. 1—FREQUENCY CHANGER WITH GUARD RAIL AND FOOT PLATE

The switchboard at the right was boxed later to protect employees against possible short-circuits.

Racks for Furnace Tools

Furnace tools left lying on boiler-room floors, it is pointed out, may cause employees to trip and suffer serious injuries. A blacksmith can make a practical rack for such tools at small expense, and all tools should be kept on this rack when not in use.

Another tripping hazard is presented by the stringing of testing lead wires across passageways and the use of lamp-cord runs in offices.

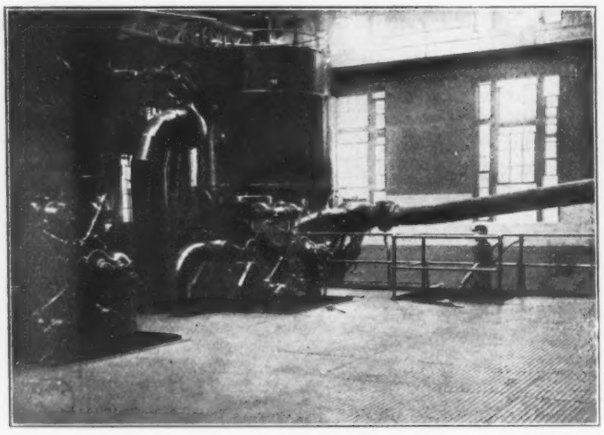


FIG. 2—OPERATING FLOOR WITH ANGLE-IRON LEDGES TO PREVENT TOOLS FROM FALLING

A dangerous practice common among engine-room attendants is that of wiping pulley faces carrying belts running at high speed. A slip of the hand or the catching of a strand of waste in the running belt might result in the loss of the employee's arm or his life. Guards should be placed around such belts and instructions issued not to touch belts or pulleys while in motion.

Protection for Men on High-Tension Lines

As long as men are working on switchboards or lines in "U. G. I." plants, cards are hung on the controlling switches reading, "Danger.—Do not throw switch; men working on circuit." Use of rubber gloves and safety shields is also required of all linemen working among

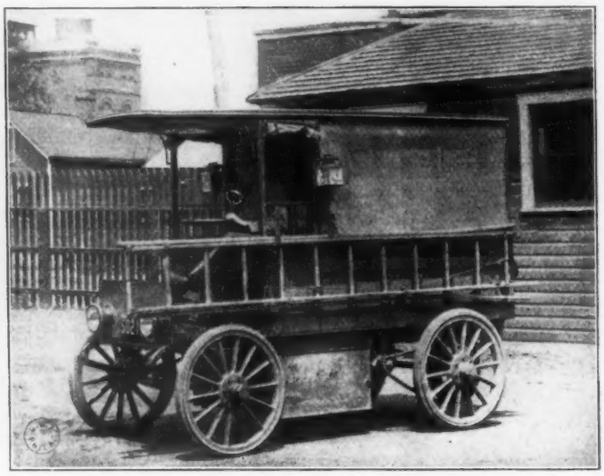


FIG. 3—APPROVED METHOD USED FOR CARRYING LADDER ON WAGON

live conductors. For electricians' use, insulated screw drivers are recommended. The shanks of these tools are insulated within a fraction of an inch of the working end. Their use will prevent burns due to short-circuits caused by tools slipping and making contact with charged conductors.

Glassware should not be stored on shelving without ledges or strips to keep it from falling and breaking. While there is little danger of employees being injured

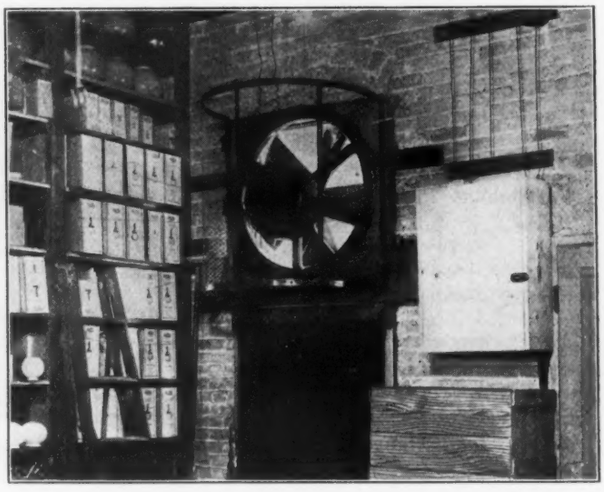


FIG. 4—WIRE GUARD PLACED AROUND EXHAUST FAN FOR PROTECTION

by falling glassware, serious injuries have resulted from their stepping on broken glass.

Hazards in Overhead Construction

In running guy wires, outside-construction men should take care that the lines are high enough at street corners to clear drivers of passing wagons. Serious accidents have resulted from neglect of this point.

Lines may be set correctly in the first place, but the leaning of the poles after a few years' service sometimes causes the wires to drop into positions where they may shock drivers or pull them off their wagons.

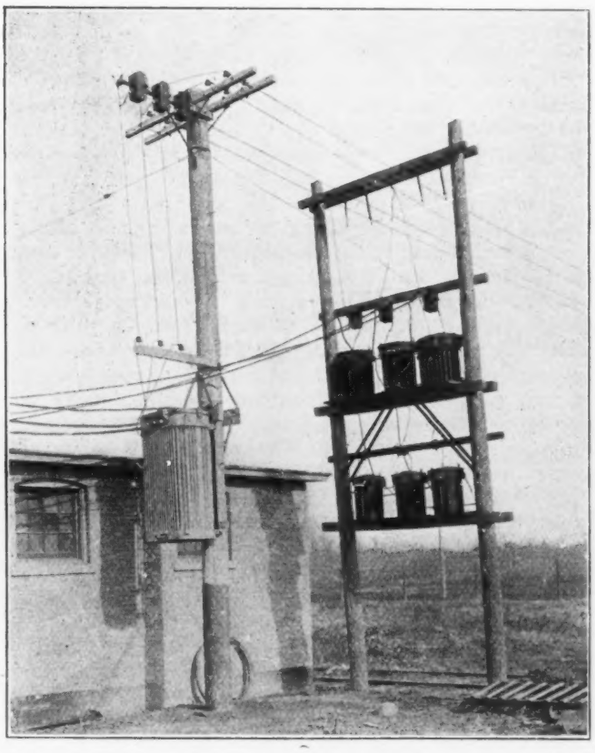
To protect adventurous youths against the penalties of their own curiosity, permanent steps or spikes should not be used on poles at a height below 8 ft. from the ground. Sockets, into which spikes or bolts may be inserted by linemen when needed, are recommended for the first 8 ft., while above this height permanent steps may be used.

While the desire of the United Gas Improvement Company to prevent accidents has, of course, been actuated by humanitarian motives, the results obtained from its safety campaign have proved of marked economic value as well; for, as pointed out by Mr. Douglas, an accident avoided means "money saved, efficiency undisturbed and protection uninterrupted."

Use of 150-kw Pole-Type, Three-Phase Transformers at Milwaukee

A feature of the advanced line-construction methods employed by the Milwaukee Electric Railway & Light Company has been the use of very large three-phase transformers for serving customers' motor installations.

The accompanying illustration shows how the mounting of transformer equipment is simplified, the space requirements are reduced and the appearance of the work is improved by replacing several single-phase transformers by a single three-phase unit. On the right is shown the old equipment which until recently supplied energy to one of the largest foundries in Milwaukee. The initial installation here comprised a bank of three single-phase transformers supported on a platform between the two poles. As the demand for service grew another platform was erected on the same poles, accommodating a second bank of transformers.



150-KW, THREE-PHASE POLE-TYPE TRANSFORMER REPLACING THE SMALLER SINGLE-PHASE UNITS

Recently the increased demand for energy in this foundry brought about another change, which consisted in replacing the half-dozen small units by the 150-kw, three-phase, sixty-cycle transformer shown mounted on the pole at the left. The method of hanging the transformer on the pole and of leading the primary wires to it represent the standard practice of the Milwaukee company. Way clamp-type insulator pins and Matthews fuse-type switches are used. The installation illustrated is declared to be one of the largest three-phase transformers ever erected on a pole. Mr. G. G. Post is electrical engineer for the company.

Etching Numbers on Glass Meter Cases

Please tell me how to etch numbers, letters and figures on glass meter cases as is the practice of some central-station companies. We have experimented with various methods of attaching company numbers and name-plates to meters, but have found none satisfactory and would like to try the plan of etching.

F. K. N.

Figures can be etched on glass with a solution of hydrofluoric acid, which attacks the glass surface, roughening it to a "sand-blast" finish. The etching fluid may be applied with an ordinary rubber-type stamp, using changeable letters in case it is desired to print consecutive numbers. Several brands of these acid etching "inks" are marketed by manufacturers of writing fluids and are well adapted for this purpose.

Work of Artillery Electrician-Sergeants

Please furnish me with information concerning the position of electrician-sergeant in the United States Coast Artillery, the requirements necessary for appointment, character of duties and amount of pay and allowances.

A. Z.

Electrician-sergeants of the second class are appointed from graduates of the electrical course of the Department of Enlisted Specialists, United States Coast Artillery School, Fort Monroe, Va. In order to be eligible for the school the candidate must have had at least one and one-half years' service in the Coast Artillery Corps. The curriculum of the school course includes instruction in the fundamental principles of electricity, use of instruments, operation of generators and motors, testing of cables and apparatus, care of telephones, storage batteries and search-lamps, interior and exterior wiring, cable splicing, construction and operation of fire-control installations and wireless telegraph and telephone systems, machine-shop practice and principles of power-plant operation. Electrician-sergeants who have served in the second class are eligible through competitive examinations to positions as electrician-sergeants of the first class and to the still higher rank of "master electrician." Electrician-sergeants, first class, are charged with the supervision, care and operation of electrical installations, including search-lamps and power plants when necessary. Electrician-sergeants of the second class have similar duties, including the care of lines and means of communication and smaller power plants. The monthly pay of an electrician-sergeant, second class, is $36; that of an electrician-sergeant, first class, is $45, with an increase of $4 per month for each additional enlistment. The men are furnished their quarters (with excellent bathing facilities) heat, light, rations and clothing.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Rheostats for Direct-Current Motors.—J. CACHOT.—A long and profusely illustrated article on the calculation of starting resistances and regulating rheostats for direct-current motors.—*La Revue Elec.*, Nov. 21 and Dec. 5, 1913.

Heating of Dynamo-Electric Machines.—OSKAR SZILAS.—The first part of an illustrated article on a graphical method for investigating the heating of electric machines and transformers.—*Elek. u. Masch.* (Vienna), Dec. 14, 1913.

Induction Machines.—JOHANN LISSNER.—A long paper of a highly mathematical nature on the theory of induction motors and induction machines, or in general alternating-current machines without commutators, with applications to special problems.—*Elek. u. Masch.* (Vienna), Nov. 23, 30; Dec. 7 and 14, 1913.

Lamps and Lighting

Graphic Representation of the Color of Lamps.—ERICH JASSE.—An article with reference to the recent

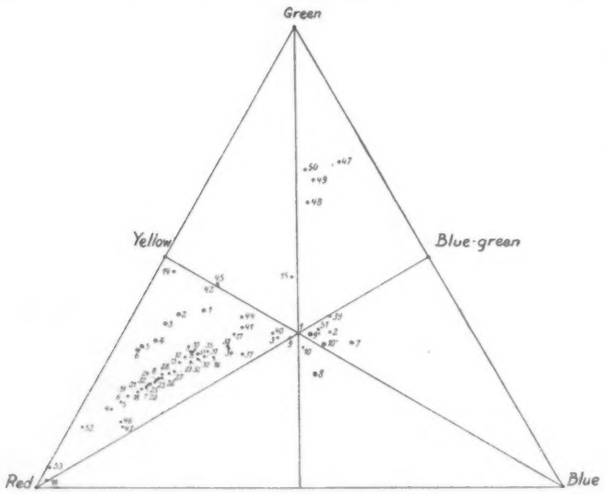


FIG. 1—COLOR TRIANGLE

article by Bloch on a method of determining the color of the light of lamps. The present author recommends the use of Maxwell's color triangle. (Fig. 1.) In any equilateral triangle the sum of the distances of any point within the triangle measured to its three sides is always the same wherever the point may be, the sum in question being equal to the distance of any angle of the triangle from the opposite side. The center point is at equal distances from all three sides, so that if it be assumed that the three fundamental colors, red, green and blue, when mixed in equal proportions, give white, the center of the triangle may be used to represent white. The three angles represent the fundamental colors in saturated condition, as indicated by "red," "blue" and "green" in Fig. 1. Any point on the line connecting the red corner with the center point thus represents a pure red more or less mixed with white. Similarly, any point in the interior of the triangle represents a definite color, and the ratio of the distances of this point from the three sides of the triangle shows the proportion of red, green and blue present in the color designated. Mixtures of two colors are shown as points on the side of the triangle connecting the angles representing those two colors. When the line connecting an angle with the center is prolonged beyond the center point, the complementary color is obtained. For instance, the prolongation of the "blue" line which connects the "blue" corner with the center point represents yellow. The results obtained by Bloch for the color values of different lamps are represented in the diagram by simple points and figures. For example, 1 (the center point) is daylight; 14 is the light of the Bunsen burner with sodium (almost saturated yellow); 15 is the thallium Bunsen burner (light green); 16 is the lithium Bunsen burner (almost saturated red). Points 18, 19 and 20 represent carbon incandescent lamps consuming 4, 3.5 and 3 watts per candle-power respectively; 21 and 22 are for graphitized-carbon lamp consuming 2.5 watts and 2 watts per candle-power respectively; 25 shows the tantalum lamp taking 1.7 watts per candle-power, and 26, 27, 28, 29, 30 and 31 represent tungsten units consuming 1.2, 1, 0.8, 0.6, 0.5 and 0.4 watt per candle-power respectively. Point 34 shows the light of a pure-carbon arc lamp without a globe; 40 the magnetite-arc lamp, and 41, 42 and 43 intensive flame-arc lamps for white, yellow and red light respectively. Point 47 shows the glass-tube mercury-vapor lamp, and 49 the quartz-tube mercury-vapor lamp without a globe. Points 51, 52 and 53 show Moore tube using carbon dioxide, nitrogen and neon respectively. Some results of H. E. Ives are also entered in the diagram as dots surrounded with a little circle. Point 2 refers to a Welsbach mantle with 0.75 cerium, 4 to the tungsten lamp taking 1.25 watt per cp, 5 to the tantalum lamp taking 2 watts per cp, 6 to the carbon lamp at 3.1 watts per cp, and 7 to the mercury-vapor lamp at 0.55 watt per cp. Considerable differences exist between the results of Bloch and Ives and other observers. The author recommends that Bloch's method be investigated further, especially to compare the results thus obtained with those secured by the spectrophotometric method, in order to determine the exactness of the former. Another source of error pointed out is the standardization of the comparison lamp.—*Elek. Zeit.*, Dec. 18, 1913.

German Lamp Tax.—F. FASOLT.—The conclusion of his statistical article on the manufacture and taxation of electric lamps in Germany and the consumption of lamps in Germany and their export to other countries. The financial results of the tax are criticised and their effect on German manufacturers is discussed, especially with respect to the method of figuring the tax on the cost of the lamps according to the tariff laws of Canada and the United States. The author urges that the lamp taxation law should be abolished.—*Elek. Zeit.*, Dec. 18, 1913.

Electric Automobile Lighting.—EMIL DICK.—An illustrated description of a system for lighting automobiles by means of an axle-driven dynamo in combination with a storage battery. The system is an execution in miniature of the author's railway-car lighting system. —*Elek. u. Masch.* (Vienna), Dec. 14, 1913.

Generation, Transmission and Distribution

Tractive Force of Electromagnets.—PAUL KALISCH.—A long mathematical article, illustrated by diagrams, on the calculation of the tractive force of lifting electromagnets. Maxwell's formula for the tractive force is not altogether correct, but a generally accurate formula has not yet been found. It is recommended that Maxwell's formula be used with a correction factor.—*Elek. Kraftbet. u. Bahnen,* Dec. 4, 1913.

Surges in High-Tension Transmission Lines.—FELIX FINCKH.—An article on real and imaginary surges in high-tension transmission lines. The author points out that in the case of many accidents it is not possible to decide whether they were due to surge phenomena causing a high voltage or to other causes. Especially in the case of short-circuits between windings in machines and transformers a great many different causes may be assigned. Before steps are taken to prevent the recurrence of such accidents it is important to find out the exact reason, and to do this an accurate knowledge of the peculiarity of the design of the machines, etc., is necessary. The manufacturers who first built the machines are best able to do this.—*Elek. Zeit.,* December, 1913.

Gas Engines.—E. G. COKER AND W. A. SCOBLE.—An abstract of a paper read before the (British) Institution of Civil Engineers on cyclic changes of temperature in gas-engine cylinders.—London *Electrician,* Dec. 19, 1913.

Traction

Energy Supply to Railways by Central Stations.—THIERBACH.—The author emphasizes the fact that the cost of generating energy in a central station can be very much reduced if the plant also supplies power for traction. This is especially true when a rate schedule is employed according to which the customer pays a fixed flat rate for the maximum kw demanded and also a small unit charge per killowatt-hour for the energy consumed during the year. For those hours during the evenings in the winter in which the lighting load curve has its maximum, it is recommended that the traction energy be obtained from a large storage battery which could be charged during the remainder of the day. The author investigates in detail the economy of this arrangement.—*Elek. Kraftbet. u. Bahnen,* Dec. 14, 1913.

British Railway Statistics.—The annual tables of statistics of British electric railways obtaining energy from combined lighting and traction power houses. These systems number 141. In another set of tables a list is given of British railways with power houses supplying traction energy only, their number being 43. A list is also given of fifteen British electric railways now in operation. The information presented includes a description of the routes followed, names of officials and details of track, overhead equipment, rolling stock, etc. —Supplement London *Electrician,* Dec. 19, 1913.

Lötschberg Single-Phase Railway.—The conclusion of the long illustrated article on the single-phase railway from Spiez to Brig (Lötschberg tunnel railway). In the present instalment L. Thormann gives details of the power plants and transmission lines.—*Elek. Zeit.,* Dec. 18, 1913.

High-Tension Direct-Current Railways.—A list of forty-nine high-tension direct-current railways in Europe. Forty-six of these employ two conductors. The trolley potential varies from 800 volts to 2000 volts, the motor pressure from 500 volts to 1200 volts. Three roads employ three conductors, the pressure being 2×600 volts, 2×700 volts, and 2×1200 volts, respectively.—*La Lumière Elec.,* December, 1913.

Prevention of Accidents on Railways.—VON KNAPITSCH.—An illustrated article on the means employed to prevent accidents on the Vienna street railways. One of the principal methods is the use of moving pictures illustrating correct and improper ways of entering and leaving street cars.—*Elek. Kraftbet. u. Bahnen,* Dec. 14, 1913.

Electric Locomotives.—F. LYDALL.—A paper giving diagrams and design data of twenty-seven different electric locomotives—London *Electrician,* Dec. 19, 1913.

Electrical Equipment for Automobiles.—A. ARMAGNAT.—An illustrated account of recent progress in lighting dynamos, electric starters and combined lighting and starting equipments for automobiles.—*La Revue Elec.,* Dec. 5, 1913.

Installations, Systems and Appliances

German Central-Station Statistics.—GEORG DETTMAR.—A summary of the status of German central stations on April 1, 1913. While these statistics were formerly issued every year, the report now appears only every two years. The present statistics show the excellent condition and the very rapid growth of German central stations. In 1907 there were 1530 municipal plants in Germany, in 1909 there were 1978, in 1911 there were 2526, and in 1913 there were 4040, so that the increase by two-year periods was 448 from 1907 to 1909, 548 from 1909 to 1911, and 1,514 from 1911 to 1913. The rapid increase in the last few years is also illustrated in Fig. 2, which shows the development of German central stations from 1895 to 1913. Different curves give the number of stations, the total connected load in millions of kilowatts, lighting load, stationary-motor load, railway load and load due to heating and cooking apparatus. Since many of the central stations transmit energy to other cities, there are at least 17,500 cities in Germany now supplied with electricity, which represents an increase of 6500 cities, or 60 per cent in the last two years. The number of connected lamps and their equivalent in kilowatts is shown in the accompanying table. This shows the rapid increase in incandescent lamps, while for the first time that statistics are

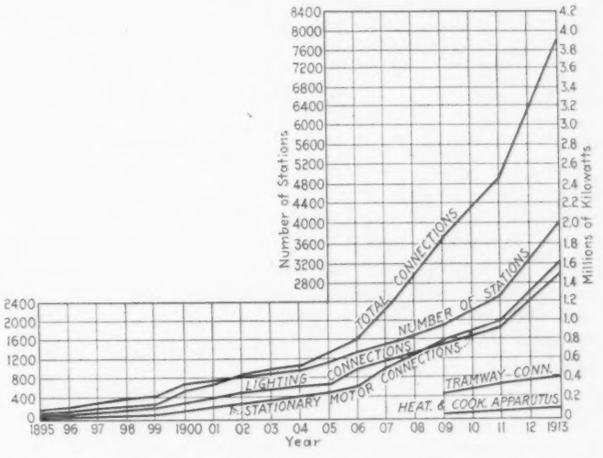

Number of Stations
Millions of Kilowatts
Year
TOTAL CONNECTIONS
NUMBER OF STATIONS
LIGHTING CONNECTIONS
STATIONARY MOTOR CONNECTIONS
TRAMWAY CONN.
HEAT. & COOK. APPARATUS
1895 96 97 98 99 1900 01 02 03 04 05 06 07 08 09 10 11 12 1913

FIG. 2—CURVES SHOWING DEVELOPMENT OF GERMAN CENTRAL STATIONS

DATA ON LAMPS, GERMAN CENTRAL STATION

Year	Number of Incandescent Lamps Connected	Kw of Incandescent Lamps Connected	Number of Arc Lamps Connected	Kw of Arc Lamps Connected
1909.....	12,808,351	640,418	234,566	117,283
1911.....	16,209,233	810,462	245,772	122,886
1913.....	24,554,381	1,227,719	230,190	116,095

available there has during the last two years been a reduction of arc lamps, owing to the introduction of high-candle-power incandescent lamps. The number and capacity of stationary motors has also been greatly increased. The total connected load of German central stations has been doubled during the last four years. Fig. 3 gives curves for the different distribution sys-

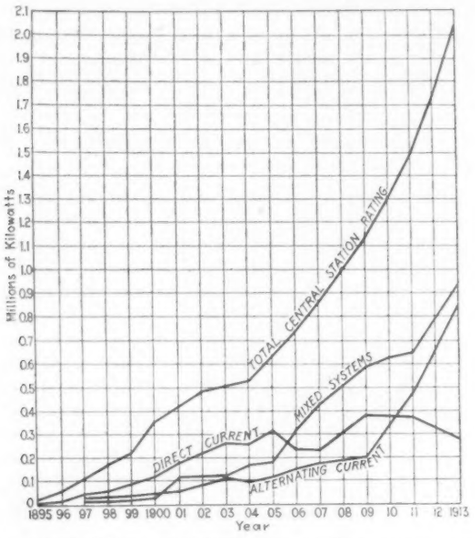


FIG. 3—VARIATIONS OF DIFFERENT DISTRIBUTION SYSTEMS

tems used. While the direct-current systems have decreased in rating during the last two years the mixed direct-current and alternating-current systems, and especially the pure alternating-current systems, show a very large increase. While the average increase of capacity of machines installed in stations within two years was formerly 250,000 kw, the increase during the last two years has been more than 600,000 kw. Particularly do the stations with ratings from 2000 kw to 5000 kw show large growths. Of the 1880 direct-cur-

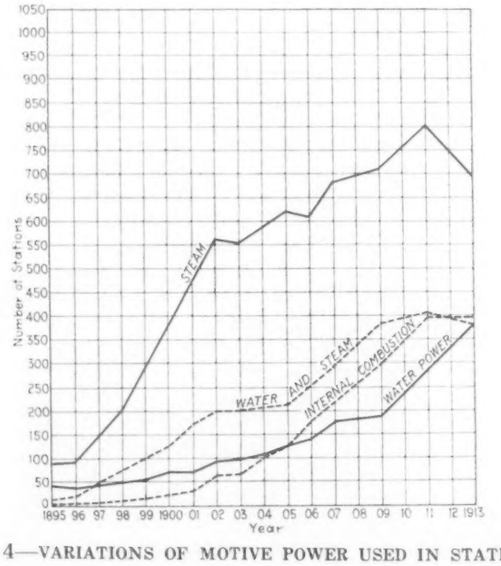


FIG. 4—VARIATIONS OF MOTIVE POWER USED IN STATIONS

rent stations 1015 use the two-wire system, 862 the three-wire system, and three the five-wire system. Of the 278 mixed systems thirteen use direct current and single-phase alternating current, while 265 supply direct current and three-phase energy. In answer to the question whether the communities with electric service contain also gas plants no information is available from 1936 cities, while in other cities 1576 have no gas plants, and 528 have a gas supply. In 1913 2833 stations were owned by private individuals or companies and 1012 by municipalities or the State. In all, 198 stations supply energy for traction. Out of 2953 stations which furnished information on the subject of distributing networks, 122 stations have cable systems, 2221 stations have overhead wires and 610 stations both cables and overhead wires. As to meters in use, 707,359 meters are used for lighting only, 152,821 for motor service, and 792,852 for both lighting and motors. Some 15,000 prepayment meters are in use. The number of consumers who have flat-rate schedules, as far as this can be ascertained, is 146,730. Fig. 4 gives the curves for the motive power in use in the stations. The number of steam stations is still the highest, and although it has slightly increased during the last two years, the number of water-power stations has grown rapidly. From 733 stations reports were received giving information on the energy sold. From 1909 to 1911 it totaled 1,254,253,000 kw-hr., and from 1911 to 1913 it was 1,949,092,000 kw-hr., which shows an increase of 55.4 per cent in two years, or 28 per cent in one year. The annual increase was formerly only 15.9 per cent. There are now 103 stations in Germany having a rating of more than 5000 kw each. Their aggregate rating is 1,560,752 kw. Eleven stations have a capacity of more than 25,000 kw. These are the Berlin Electricity Works (192,732 kw), the Düsseldorf-Reisholz system (65,000 kw), the Upper Silesian Electricity Works in Gleiwitz (59,000 kw), the municipal station in Hamburg (44,325 kw), Essen (39,400 kw), Hagen (38,500 kw), Frankfort-on-the-Main (36,734 kw), Saarbrücken mining department (33,000 kw), the municipal station at Munich (32,968 kw), Berlin-Schoeneberg (26,630 kw), and Mülhausen (25,052 kw). —*Elek. Zeit.*, Dec. 18, 1913.

Co-operative Control of Central-Station Properties.—R. A. CHATTOCK.—The author refers to a development which has been going on in Germany during the last few years. Privately owned central stations were the rule at first, but these apparently used their monopolies to the detriment of the consumer. A reaction in favor of municipal control followed, but this has also proved not entirely satisfactory since the machinery available for the management of these undertakings was found too cumbersome and inelastic. The outcome has thus been a condition of dual control under which the company manages the property and the municipalities concerned assist in financing it and are represented on the supervising board. The advantages claimed for this arrangement are that company control appears to be more flexible; it is not subject to boundary restrictions and can include in its operations large areas comprising many municipalities; full advantage can be taken of centralization and its beneficial effect upon cheapening the cost of production; special rates can be better negotiated; the property can be extended more quickly and readily to meet industrial requirements; municipal finance can provide the capital required at a cheap rate of interest, and small as well as large municipalities can become interested in and can join in the same central-station system without allowing mutual jealousies to interfere. The procedure as regards opening streets for laying mains and dealing with other municipal departments, such as water, gas, railways, etc., is also declared to be made much easier. While this development in Germany is believed to be a step in the right direction, the author thinks it does not go nearly far enough as the supply of electric energy is still exploited with the sole ultimate object of earning profits. His ideal is nationalization of electricity supply, that is, control of the whole of the supply by a government

department in a way similar to the control of the post office.—London *Elec. Review*, Dec. 19, 1913.

Starting Internal-Combustion Motors.—O. H. WILDT. —A long article, illustrated by diagrams, on the various methods used for starting internal-combustion motors. —*Revue de Mécanique*, July 31, 1913; an abstract with illustrations in *La Revue Elec.*, Nov. 21, 1913.

Wires, Wiring and Conduits

Conductivity of Aluminum and Heat Treatment.—H. GEWECKE.—When sheet aluminum is heated for two hours at 215 deg. C., or for one hour at 230 deg. C., its conductivity is found to be improved by 6 per cent without seriously affecting the mechanical properties of the metal. Aluminum wire can be handled in the same way, but the loss of mechanical strength is very serious in this case.—From *Zeit. d. Ver. Deutscher Ing.*, translated in London *Electrician*, Dec. 19, 1913.

Electrophysics and Magnetism

Photo-electric Effect.—R. POHL AND P. PRINGSHEIN. —A paper on the long-wave limits of the normal photo-electric effect. The authors conclude that from the experimental data at present known it may be regarded as pretty firmly established that the long-wave limit of the normal photo-electric effect furnishes a measure of the binding force between the electrons and the illuminated molecule. On the other hand, any attempt to formulate this relation quantitatively is met with the difficulty that the values for the long-wave limits of the normal photo-electric effect in the case of many metals and alloys are subject to variations as great as an octave and more. This difficulty is all the more real in that as yet we are not in a position to determine what influences on and in the extremely thin bounding surface of the metal in which light absorption takes place are the determining factors in this displacement.—*Philos. Mag.*, December, 1913.

Mechanical Effect of Magnetism.—S. R. WILLIAMS. —A continuation of his comparative studies of magnetic phenomena. In the present instalment the author deals with the twist in steel and nickel rods due to longitudinal magnetic fields. His results show that for some specimens of ferro-magnetic substances two mechanical effects may occur when a longitudinal magnetic field is imposed upon them, namely, a change in length and a twist. These effects and also other magnetostrictive effects are larger in nickel than in iron and steel. The fact that a mechanical effect due to magnetization can occur in a rod because somewhere in its history it has suffered some change in its structure proves emphatically that one must be very sure how the specimens were prepared, else there can be no way of comparing one observer's results with another, and hopeless confusion arises.—*Amer. Jour. of Science*, November, 1913.

Electrochemistry and Batteries

Electrolytic Production of Perforated Copper Tubing for Radiators.—An illustrated description of the Feldkamp process. In this a flat lead strip, say 0.125 in. in thickness and perforated at intervals with 0.25-in. holes staggered with reference to each other, is electroplated with copper, after which the strip is cut into suitable lengths. These are heated above the melting point of leads, thus melting out the lead core. What remains is the copper plating in the form of a light copper tubing having an internal contour corresponding to the original perforated lead strip. This is used for automobile radiators, for radiators for house heating systems, etc. The electroplating process is continuous, the lead passing in the form of a long strip through the bath, in each side of which are anodes in the form of wires. There is no anode scrap, and the thinner wire passing out of the bath has a higher value per pound than the thicker wire which passes in.—*Metall. and Chem. Eng'ing*, January, 1914.

Nitrates by Electrolysis.—G. DARY.—An illustrated article on the Nodon scheme of producing nitrates by direct electrolysis of peat deposits.—London *Elec. Review*, Dec. 19, 1913.

Units, Measurements and Instruments

Single-Phase Power-Factor Indicators for Variable Frequency.—LEONARD MURPHY.—The author thinks that the comparative lack of popularity of power-factor indicators for testing-room and laboratory work is mainly due to the non-adaptability of the single-phase type to measurements at various frequencies. The voltage element of a single-phase instrument usually consists of two fine-wire coils, mechanically at right angles and rigidly fixed together. One of these is excited with energy tapped off across the line potential through a high non-inductive resistance, while the other coil is excited in a similar manner, except that the resistance is replaced by a choking coil or a condenser. The readings of such instruments depend on the frequency of the current. A simple method of overcoming this difficulty to some extent is shown in Fig. 5. It involves the use of both a choke coil and a condenser. The cross coil is divided into two parts, one of which, *B*, carries the choke-coil current, and the other, *B'*, that from the condenser. These two parts are wound

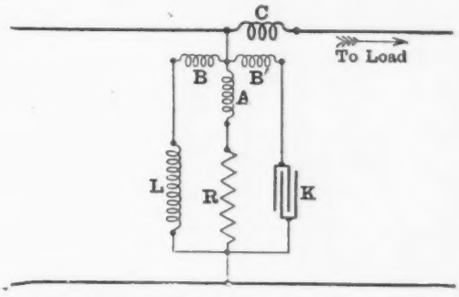


FIG. 5—SINGLE-PHASE POWER-FACTOR INDICATOR

one over the other and are so connected that the leading current from the condenser produces a magnetic field in the same direction at any instant as the lagging current from the choke coil. Thus the ampere-turns on the two parts of the coil are added together, although the currents are 180 deg. out of phase, the result being that the totol cross ampere-turns tend to become constant, even though the frequency is varied considerably. Thus, for example, an instrument may be arranged to work over a frequency range of thirty-two cycles to seventy-eight cycles per second, with only a 10 per cent variation in the total cross ampere-turns.—London *Electrician*, Dec. 19, 1913.

Exhibition of Instruments.—An account of a recent exhibition of the Physical Society in London. Besides the exhibition experimental lectures were given. The exhibits included the electrostatic oscillograph of Ho and Koto, recently described in the Digest; Duddell standard coils, the Coblentz linear bismuth-silver thermopile, etc. The article is to be continued.—London *Electrician*, Dec. 19, 1913.

Telegraphy, Telephony and Signals

Telephone Relays.—The British and German telephone departments are engaged in making experiments with telephone relays on lines from London to Cologne and Berlin, using the Anglo-Belgium submarine cable. The line from London to Brussels is equivalent to 22 miles of standard cable; Brussels to Cologne, 8 miles, and Cologne to Berlin, 20 miles. By inserting a tele-

phone relay at Brussels the speech between London and Cologne was equal to that through only 20 miles of standard cable so that even between London and Berlin speech could be heard. Two types of relay were employed, namely, the Brown relay and the Lieben-Reisz relay. The latter has been described in detail recently in the Digest. The older form of the Brown relay has also been formerly described in the Digest, but in the recent experiments a new form is used. In this the secondary contact is a microphone chamber containing carbon granules instead of the minute "condition space" between a platinum point and disk employed in the earliest pattern, although subsequently replaced by an iridium point and hard-carbon plate in the relays for wireless telegraphy. A diagram of the instrument is seen in Fig. 6. In the latter N is the permanent magnet, on the pole-pieces H of which are wound two coils carrying the current received from the line. A steel reed P can be adjusted by the screw W, and has the front of the microphone chamber M fixed to its upper end, which faces the pole pieces of the permanent magnet, making an almost complete magnetic circuit with a very small air gap. The microphone chamber contains two carbon-faced electrodes and is nearly filled with fine carbon granules. The tension of the reed is adjusted by the screw W until the reed is on the point of dropping against the pole pieces, so that its elasticity is nearly balanced by the magnet pull. S is a stop screw to prevent the reed from falling against the mag-

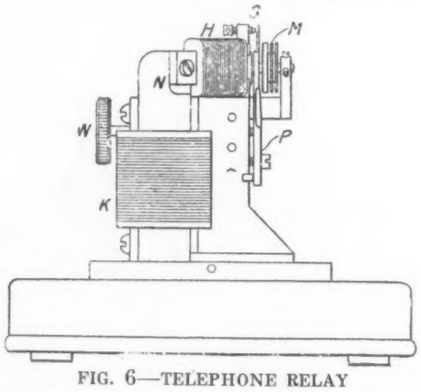


FIG. 6—TELEPHONE RELAY

net faces. K is a regulating winding in series with the microphone; it prevents any considerable drop in the steady current when the relay is strongly operated, and also, by its telephonic action, intensifies the magnifying power of the instrument. The relay is used with a condenser in series on its primary side; while the circuit of the secondary side is made up of a battery, the primary of an induction coil and the microphone chamber. According to Brown, the relay will magnify the current about twenty times, and its use corresponds to a saving equivalent to the loss in 30 miles of standard cable. If inserted in the middle of an ordinary simplex line, a relay has, of course, the disadvantage that it can work in only one direction, and in early experiments the line was duplexed. There is, however, difficulty in maintaining good balance on such a duplexed telephone line owing to variations in insulation resistance and varying terminal conditions. Duplexing also, of course, halves the transmitted and received currents. Brown, therefore, now uses a highly sensitive simplex automatic switch to reverse the relay connections according to the direction of the received speaking currents.—London *Elec. Eng'ing*, Dec. 18, 1913.

Huertley Magnifier.—An editorial note on the Huertley magnifier which was shown at the recent exhibition of the Physical Society in London and which depends upon the variation of resistance of two platinum wires forming two sides of a Wheatstone bridge. Each of these wires is mounted over a slit in a tube through which air is blown. The movement of the receiving coil, such as is used in a siphon recorder, is transmitted to these wires by silk fibers and the resultant movement causes one wire to be drawn further out of the stream of air, while the other is drawn further into it. The wires are maintained hot by passing a current through them, and thus each movement causes a considerable variation of resistance. In actual operation the movement is barely visible. The instrument is capable of receiving seventy-five words per minute with 0.7 microamp.—London *Electrician*, Dec. 19, 1913.

Book Review

ELECTRICAL ENGINEERING. By Clarence V. Christie. New York, N. Y.: McGraw-Hill Book Company, Inc. 417 pages, illus. Price, $4 net.

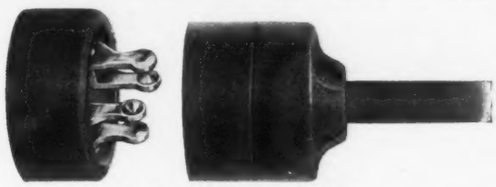
A single volume cannot cover the whole field of electrical engineering, even if practical details are entirely omitted. For this reason, the title of Professor Christie's book fails to give an accurate indication of its contents. The book deals with the principles of electrical engineering, with special reference to dynamo-electric machinery and transformers. The brief preface is, however, a correct guide to the subject treated and to the method of treatment. To quote the author: "This book has been compiled as a foundation for lecture courses for junior and senior students in electrical engineering," and the further statement is made that the general groundwork may be extended to suit the requirements of particular classes. It may be said without hesitation that the task the author set himself to do he has executed in an admirable manner. The book is entirely without superfluous matter, a most desirable feature if the principle of condensation is not carried too far; the fundamentals are clearly stated, and the necessary proofs are given in well-worded and accurate language. In the opinion of the reviewer, this is essentially a teacher's book, forming an excellent groundwork capable of expansion and further illustration as the case demands. Chapter I is devoted to electrostatics, a subject usually neglected or treated inadequately in textbooks on electrical engineering subjects. Chapter II deals with the principles of the magnetic circuit, and Chapter III with electric circuits. The remaining seven chapters treat mainly of the elements and theories underlying the design and operation of transformers and both direct-current and alternating-current machinery. In the last chapter the principal formulas for transmission line calculations are developed. The author's method of determining the inductance of parallel wires might be challenged. He integrates between the limits R and $(D - R)$, thus departing from the usual method, which takes into account the flux from the surface of the outgoing wire to the *center* of the (cylindrical) return conductor. The difference in practical work will usually be negligible, but the formula in general use is simpler in appearance and more accurate. The commendable tendency to condense and avoid verboseness or the introduction of unnecessary material is occasionally the cause of too little being said; thus, on page 174, the saving of a few words leads to possible confusion in the minds of readers, who can be imagined as attempting to picture, with varying degrees of success, the existence in the armature windings of a current due to no apparent cause. Such criticisms are, however, of minor importance. They do not detract from the value of the book, which should appeal to a large number of teachers and students.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Motor Attachment Plug

The attachment plug illustrated herewith has been designed by the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., for small portable motor-driven devices such as vacuum cleaners, grinders, floor polishers, compressors, etc. The base of the plug can



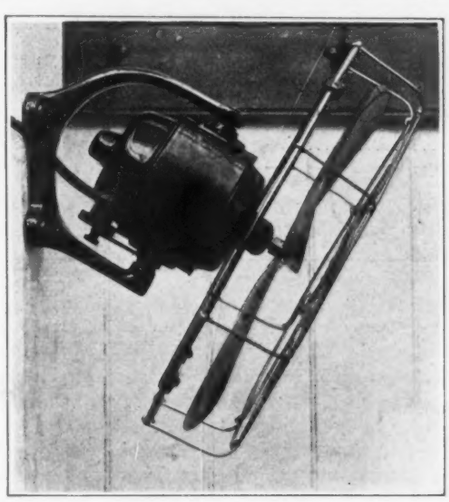
ATTACHMENT PLUG

be permanently secured to the motor frame, which is provided with rugged double lugs. The contacts are dead when the device is not in use, the live contacts of the part attached to the flexible cord being sunk below the surface.

A heat-resisting material called "Thermoplax" is used in the construction of this plug, which is rated at 10 amp and 250 volts. The heavy double lugs and contacts are so designed that the plug can be separated by a pull at any angle.

Ball-Bearing Bracket Oscillating Fan

The oscillating fan illustrated herewith is supported by a cast-iron bracket inclined at a fixed angle of 25



OSCILLATING FAN ATTACHED TO WALL BRACKET

deg. The fan is equipped with ball bearings which permit the body to oscillate with a minimum amount of friction. All of the oscillating mechanism is entirely concealed within the rear-end cover, leaving visible only the revolving disk and lever. By twisting a knurled head in the disk the arc of oscillation may be varied in three steps from 90 deg. to zero, at which latter point the fan stops oscillating. The fore part of the shaft is supported by a ball bearing to take up the forward thrust. The body casing and end covers are made of pressed metal, and the motor frame is laminated. A speed regulator giving three running speeds has been designed for use with this fan, which is made by the Diehl Manufacturing Company, Elizabeth, N. J.

Electric Starting and Lighting Equipment for Automobiles

The United States Light & Heating Company, Niagara Falls, N. Y., is manufacturing a combined motor and generator for starting automobile engines and for charging the batteries and providing energy for the lighting equipment. The armature is of flywheel size and weight and is bolted to the flange of the engine crank-shaft in place of the usual cast-iron flywheel.

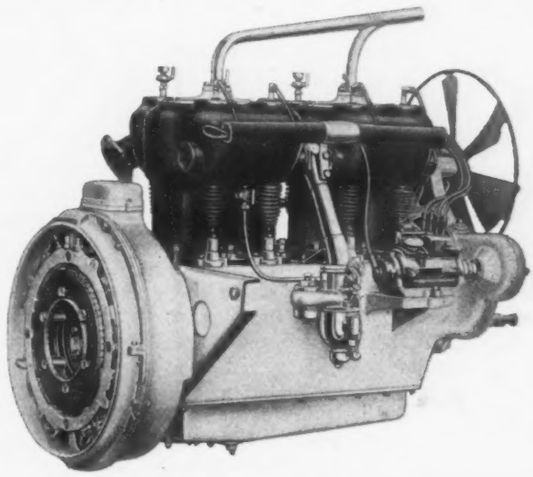


FIG. 1—MOTOR-GENERATOR MOUNTED ON ENGINE

In the 1914 model all external regulating devices, such as carbon piles and other resistances have been eliminated, the regulation being accomplished by a new disposition of the copper-wire coils of the machine.

When the starting button is pressed down the armature and the field coils become energized, causing the armature to revolve at a speed varying from 200 r.p.m. to 400 r.p.m. The motor-generator not only acts as a starter and as a generator but also as a flywheel. After the foot-button has been pressed down the engine commences to fire; the button is then released and the machine is automatically changed from a starting motor to a charging and lighting generator driven by the engine. At a definite engine speed the automatic switch closes and the energy passes from the generator to the battery.

The starting switch is installed beneath the floor-board with the push-button protruding within easy reach of the driver's foot. The device is of the re-

volving-drum type and has contacts similar to those used in street-car controllers. The contacts break in a bath of oil. The switch has two positions, one for starting and the other for charging. When the foot-button is pressed down as far as it will go starting connections are made; when the foot-button is released charging connections are made.

The automatic switch is simply a small magnetically

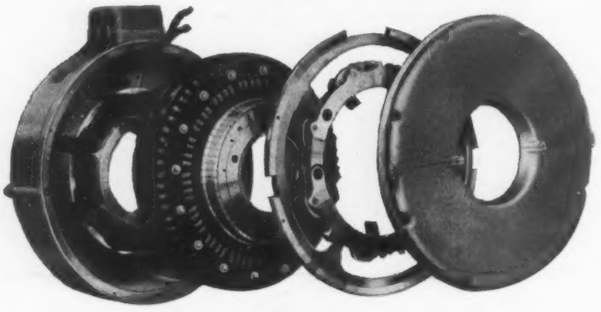


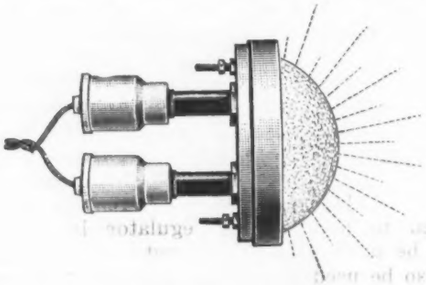
FIG. 2—DISASSEMBLED PARTS OF MOTOR GENERATOR

operated carbon-break switch which closes the charging circuit when the generator voltage is sufficient for charging and opens when the generator voltage falls below that of the battery.

The machine is designed in a range of sizes from a 60-ft.-lb. starter for a small four-cylinder engine to a 400-ft.-lb. starter for an eight-cylinder fire-pump engine. Fig. 1 shows the motor-generator attached to a Moyer engine, and in Fig. 2 the different parts are shown disassembled.

Radiant Electric Heater

The electric "fire" heater illustrated herewith has been put on the market by Messrs. Redglo, Ltd., Liverpool, England. The heating element is entirely inclosed in a quartz dome, which is made in an electric furnace. The area of this dome is 23 sq. in. Red rays radiate from the globular face of the dome. The heating element is made of an alloy particularly adapted to withstand high temperatures for long periods. Substantial leading-in pillars, which are housed in porcelain, are carried away from the heating center and screwed into the terminals. The latter are designed for a pressure of 100 volts, but at the same time they are insulated for



ELECTRIC HEATER

pressures as high as 500 volts. The heating elements are wound for any predetermined pressure between 100 volts and 250 volts, and either direct current or alternating current can be used.

Each unit consumes 600 watts and measures 7 in. over all from the tip of the quartz dome to the end of the terminals. The dome is 5.125 in. in diameter, and the complete weight of the device is only 2 lb.

Electric Versus Gasoline-Truck Operating Costs

If the local conditions are known, it is a simple process to compute the comparative costs of operating gasoline and electric trucks, as pointed out by Mr. E. J. Bartlett, of the Baker Motor Vehicle Company, Cleveland, Ohio. In general terms a comparison of the operating costs of an electric and a gasoline truck of the same load capacity, traveling the same number of miles per day, is given below:

Driver.—Saving of $156 per year over electric truck since a mechanic is not required to operate and care for the electric truck, making a difference in wages of $3 per week.

TABLE I—DAILY OPERATING COSTS, ELECTRIC AND GASOLINE TRUCKS

Size of Truck	Battery Wear and Charging Energy	Fuel and Engine Lubricating Costs
1000-lb. truck	$1.03	$0.65
2000-lb. truck	1.25	0.85
4000-lb. truck	1.47	1.00
7000-lb. truck	1.93	1.40

Tire Wear.—About the same as with the gasoline cars. Electric-truck tires wear longer owing to the slower speed, but they also cost more owing to the more resilient qualities necessary to propel the truck with the least power.

Battery Wear.—The items of battery wear and charging energy should be considered as fuel cost and will vary with the cost of energy and size and type of battery. If an energy cost of 3 cents per kw-hr. is assumed, using figures computed for the "Exide Ironclad" battery as an average equipment, the daily costs will be approximately as in Table I, compared with gasoline operation at 17 cents per gallon.

TABLE II—REPAIR AND DEPRECIATION PER YEAR

Size of Truck	Electric	Gasoline
1000-lb	$260	$600
2000-lb	300	700
4000-lb	390	900
7000-lb	495	1130

These figures show that the gasoline-truck fuel and lubricating oil alone cost over one-half as much as the combined cost of battery wear and charging current for the electric truck.

Repair Parts, Labor and Depreciation.—As the above item already provides for battery wear, there is left in the case of the electric truck a simple, sturdy mechanism which requires very little in the way of repair parts and labor to keep it in excellent operating condition.

In addition to these simple parts, such as axles, springs, frame, etc., which are similar in construction in both electric and gasoline trucks, the latter includes a complicated reciprocating gas engine, a train of clash gears or transmission, clutch, gear-shifting devices, etc. The repairs, of course, are very much higher for the gasoline truck, and its efficient life is about one-half that of the electric truck, or five years against ten. Assuming the initial cost to be the same for the two types, we have in Table II a comparison for the different sizes.

Assuming interest on the investment, insurance, storage, painting, etc., to be the same for either type, a

summary of these figures on a basis of 300 working days per year shows the results given in Table III.

TABLE III—COST OF OPERATING VARIOUS TRUCKS PER YEAR OF 300 DAYS

Size of Truck	Electric	Gasoline	Difference in Favor of Electric
1000-lb.	$1349	$1731	$382
2000-lb.	1455	1891	436
4000-lb.	1611	2136	525
7000-lb.	1854	2486	632

In addition to this saving in operating cost more continuous service is afforded by the electric truck. It has no valves to grind, carbon deposits to be removed, ignition and carburetor parts to be repaired, nor similar minor attentions which keep the truck out of commission several days a year. The electric vehicle is simple in construction, simple to operate and always on the job with a minimum expense. It is adapted to the trucking requirements of at least 85 per cent of all lines of business, and in these cases it will operate at an economy to the owner as compared with other means used for haulage.

Automatic Voltage Regulator

The Thompson-McArthur Company, Buffalo, N. Y., is putting on the market an automatic voltage regulator which is illustrated herewith. The device is designed to keep the voltage of a generator at any desired value, regardless of variations in the engine speed or changes in the load on the generator, by automatically varying

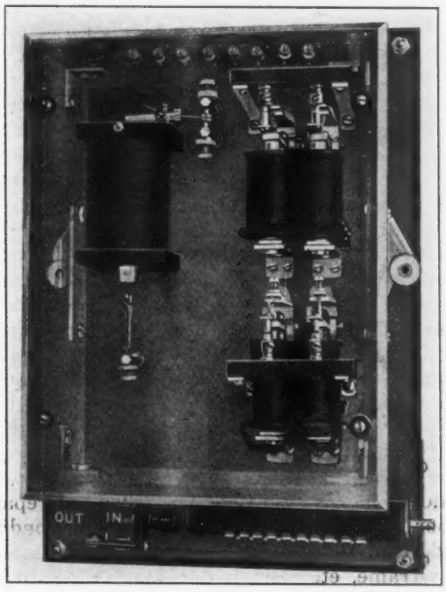


FIG. 1—AUTOMATIC VOLTAGE REGULATOR

the field strength, an operation usually done by hand. Two types of regulators are made, one designed for operation with direct current and the other for alternating current.

Referring to the diagram shown in Fig. 2, when the switch is placed in the "out" position the regulator is not in service and circuit No. 1 is in operation, the field current passing through the rheostat, which permits the usual hand control. When the switch is thrown in, circuit No. 3 is used, and if the voltage is normal the tension of the adjusting spring on the core of the control solenoid just balances the pull exerted by the solenoid field. The pivoted lever is then held in a neutral position, touching neither of the relay-control contacts. If the voltage tends to rise, however, the solenoid exerts a greater torque and pulls the core up until the

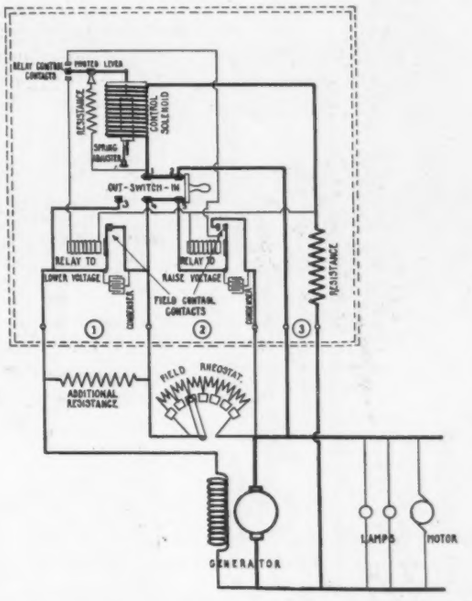


FIG. 2—WIRING DIAGRAM OF AUTOMATIC VOLTAGE REGULATOR

pivoted lever touches the lower relay contact, causing the relay for lowering the voltage to be energized. The field-control contacts ordinarily held closed by a spring are opened, and the field current has to pass through an additional resistance, thus lowering the voltage of the generator. If the voltage has a tendency to drop, the core of the control solenoid goes down and causes the pivoted lever to touch the upper relay-control contact. This action closes circuit No. 2 by energizing the relay for raising the voltage. The field rheostat is short-circuited, and the field current "builds up," therefore raising the voltage of the generator.

An alternating-current regulator has an added alternating-current solenoid to control the torque of the direct-current control solenoid and give the proper voltage to the exciter. A current transformer is also necessary to assist in controlling the exciter voltage. This current transformer can be used for line-drop compensation if so desired. A voltage transformer is necessary when the voltage of the alternator is over 500 volts. The alternating-current regulator is applied to the exciter.

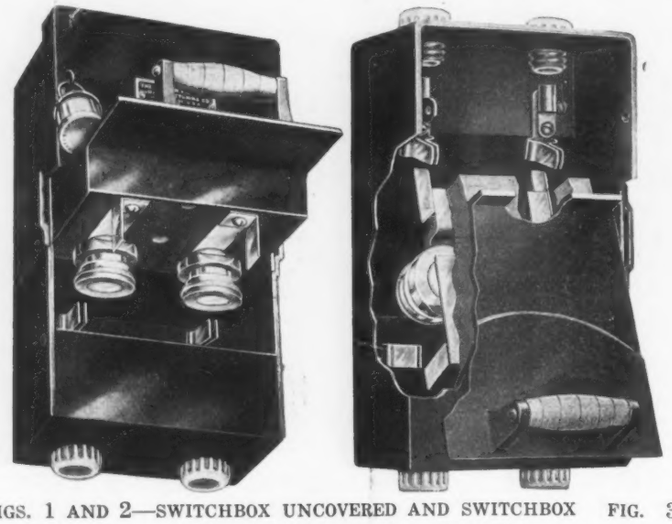
When two or more direct-current generators are operated in parallel one regulator is sufficient. It should be used with the largest unit. One regulator may also be used with more than one alternating-current generator where the exciters are operated in parallel and the exciter rheostats have a fairly wide control of voltage (30 per cent below normal).

This regulator may be used to compensate changes in line drop for either direct-current or alternating-current installations covering large areas by adding an extra winding to the control solenoid. In the direct-current regulator the compensating coil is connected to a shunt in the main line or in the busbar, while in the alternating-current device it is connected to a transformer in the line or the busbar.

Inclosed Service Switches

The service switches shown herewith are designed to meet conditions where it is desirable not to hamper the switch and fuses with seals and, at the same time, to prevent improper access to current-carrying parts of the switch and cut-out.

Fig. 1 shows one of these service switches open with the fuses exposed for inspection or replacement. The circuit is protected by ordinary Edison fuse plugs. The upper part of the box in which the service wires enter is sealed. Fig. 2 shows the same box with the cover of the service terminal chamber removed and the side of the box cut away to show the relation of the fuses and the moving switch parts. The switch and fuses are mounted on a pivoted cover and are so arranged that in opening the box the switch is disconnected from both the line and load terminals. A projecting flange upon the inner side of the cover closes that part of the box in which are the switch and fuses before the moving switch contacts engage the fixed contacts. The upper part of the base on which the switch is mounted swings downwardly into the box when opening the switch, thus forming a barrier between the open end of the box and its sealed or service end.



FIGS. 1 AND 2—SWITCHBOX UNCOVERED AND SWITCHBOX WITH COVER OF TERMINAL CHAMBER REMOVED

Small boxes are usually arranged so that the cable or conduit may enter the box directly. Fig. 3 shows how the terminals may be secured inside the box, making it impossible to remove them without breaking the seal of the terminal chamber. The terminals are designed to slip back over the pipes or cables, thus permitting the wires to be fanned out, lugs soldered on and connections made to the switch and cut-out before the terminals are drawn into place. Open-link fuses are used with this type of box. The cut-out designed for these open-link fuses is built up from single-pole units for two-pole, three-pole, four-pole or five-pole switches, the units being fastened together by the screws at *H*. The covers controlling the action of the switching members are secured to one another by the screws at *A* which engage the cross-bar *K*. In cases of emergency, therefore, an outer leg of the switch can be opened separately.

Open-fuse detectors are provided on the outer poles as indicated at *B*, so that in case one of the outer leg fuses of a three-wire circuit is opened it can be found and repaired without disturbing the operating part of the system. Since the flange of the switch cover *I* closes the opening in the box before the fuses become alive, open-link fuses can be used in this type of box, as the fuses can be blown only when the cover of the box is securely closed. The fuses and all accessible energy-carrying parts are dead when exposed, and danger of shock or accident is therefore eliminated while installing the service fuses.

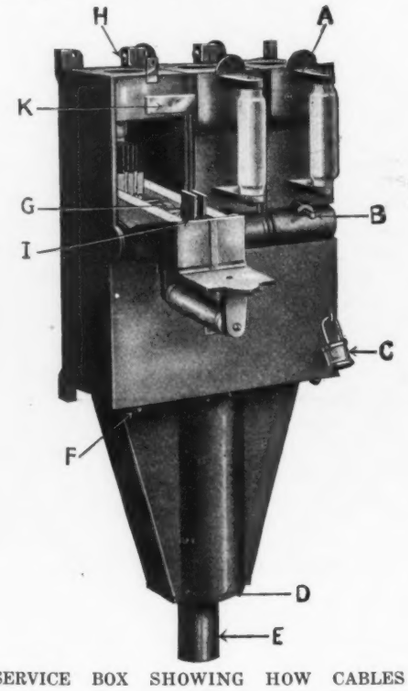


FIG. 3—SERVICE BOX SHOWING HOW CABLES ENTER BOX

These service switches are manufactured by the Palmer Electric & Manufacturing Company, Franklin and Congress Streets, Boston, Mass.

Electrical Equipment of Foreign Gasoline Cars

Judging from the equipment of foreign gasoline automobiles exhibited at the Automobile Salon held in New York Jan. 2 to 10, the manufacturers are trying to meet the demands of customers by adding every possible electrical convenience and perfecting those which have already been put in use. Several special-order cars were exhibited which were even more elaborately equipped electrically than the stock cars.

Side-lamp fixtures with the lenses cut prismatically to give the appearance of several lamps within were used on a few of the vehicles built by an Italian company. In contrast to the ugly head-lamp and side-lamp fixtures used several years ago manufacturers are now equipping their cars with lamps shaped to conform with the lines of the vehicle to which they are attached. To some cars the appearance of submarine boats has been given by inclosing the side lamps in lugs projecting from and integral with the cowl. Bullet-shaped head-lamp and side-lamp fixtures are also being used. One of the German-make cars is equipped with lighting fixtures which in addition to having the usual flat glass lenses are provided with removable bullet-shaped covers having small lenses for use where a bright, dazzling light is prohibited. These covers when not in use may be attached to the rear end of the fixture by snap clips.

In addition to the usual electric dome lamps employed in the inclosed cars, angle-bracket lighting fixtures are

being used so that the occupants of the car may have suitable illumination for reading. One of the French cars shown was equipped with a three-lamp-cluster dome fixture without the diffusing glass.

Considerable attention has been directed toward assembling all of the electrical instruments and switches (made necessary by electrical accessories) on a single panel on the footboard where they are accessible and within the view of the chauffeur. Meters and other indicating instruments on the dashboard are illuminated either by dial lamps, by ordinary bracket fixtures or by slotted cylindrical reflectors which can be rotated about a horizontal axis to reflect the light in several directions.

To another French car has been added a gang switch controlling head, side, tail and instrument lamps, with an auxiliary foot switch for simultaneously extinguishing the head lamp and lighting the side lamps or vice versa. This additional switch is convenient when automobile trips are made frequently between cities and suburbs as the chauffeur may easily extinguish the side lamps used in the city and light the brighter head lamps for country roads.

Electric lighting and starting equipment was shown on most of the cars exhibited, but is furnished only on request and not on stock cars. Westinghouse, Rushmore and the U. S. L. starting and lighting equipments are among those employed on foreign cars. More attention, it appears, is being paid to the location of these units, so as not to interfere with the operation with other apparatus, than to the design, as each of these types has given satisfaction.

A French car designed to order was exhibited with elaborate exterior and interior lighting fixtures. Electric flambeau torches supported on antique-finish copper brackets were employed as side lamps. The head lamps and tail lamps were inclosed in hand-beaten copper fixtures representing lion heads. The interior of the limousine was illuminated by electric lamps supported on Louis XV bracket fixtures and dome lamps.

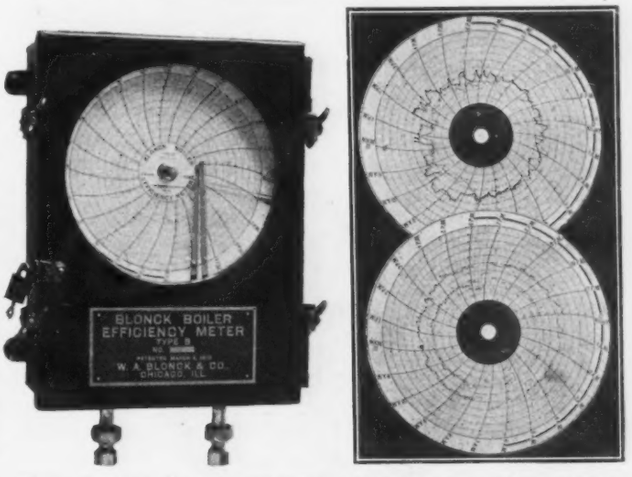
In addition to the foreign cars exhibited there were several American cars. The cars made by one American company were all equipped with Vulcan electric gear shift and the U. S. L. starting and lighting system. Another American car, in addition to being equipped with electric lighting and starting apparatus, was provided with a two-rate battery-charging switch.

Boiler-Efficiency Recording Meters

The boiler-efficiency recording meter illustrated herewith is manufactured by W. A. Blonck & Company, Fisher Building, Chicago, Ill. An indicating meter made by the same company was described in the *Electrical World* of Feb. 8, 1913. As in the indicating meter, this recording meter shows the draft resistance of the fuel bed and the drop in draft between the furnace and the damper. The two records are made on the same chart, and for clearness one is registered in red and the other in blue ink. The recorder is designed for use in conjunction with the indicating meter and should be installed where the chief engineer or superintendent may have ready access to it, while the indicating instrument may be mounted on the boiler front for the guidance of the fireman.

The charts in Fig. 2 show an example of conditions before and after the meter was applied and its use explained to the fireman. The boiler affected is a 500-hp horizontal water-tube unit fitted with a traveling chain grate. The total available draft is somewhat more than 0.8 in., water gage, and investigation showed that for the highest efficiency under normal conditions of load the draft through the fuel bed should be 0.3 in. and that through the boiler 0.5 in.

On the upper chart, taken before the fireman was instructed, the draft distribution was irregular, extreme variations occurring within short periods. The draft through the fuel bed varied from the maximum of 0.5 in. near 2 a. m. to the minimum of 0.18 in. at 2 p. m.



FIGS. 1 AND 2—BOILER-EFFICIENCY METER AND CARDS

With the damper position unchanged a decrease in the draft through the fuel bed resulted in the admission of excess air and a resultant waste. Excess air means a greater volume of gases flowing through the boiler per unit of time and hence an increase in the draft between the furnace and the damper. These facts account for the behavior of the two record lines of the charts at the points where they are converging and diverging.

When the record shows a decrease in both the draft through the fuel bed and that through the boiler, the indications are for decrease in the rate of combustion (hence decrease in steam output also) and no change in efficiency. Similarly, when increase in both furnaces and boiler draft is shown, the indications are increase in rate of steaming and no change in efficiency. Other things remaining the same, the rate of steaming or boiler capacity developed and the efficiency of the boiler depend solely upon the available draft and the distribution of that draft. This being true, it is possible to study a given set of boiler conditions quite thoroughly with the meter, so that practically all changes that occur to affect the two factors of capacity and efficiency can be instantly detected. Even falling baffles and soot or slag accumulations on the tubes may be discovered through their effect on draft distribution.

Electric Cigar Lighters for Automobiles

Although electric cigar lighters are not new, their use on automobiles is novel. Many of the large foreign

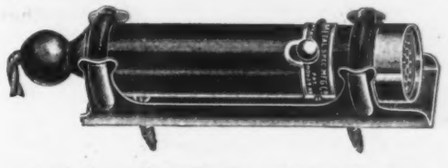


FIG. 1—CYLINDRICAL CIGAR LIGHTER

and American cars exhibited at the New York automobile shows were equipped with this new convenience. Illustrated herewith are several forms of electric light-

ers manufactured by Asch & Company, New York, for use on automobiles. The cylindrical-shaped lighter is provided with a clip-holder, and the watchcase type may

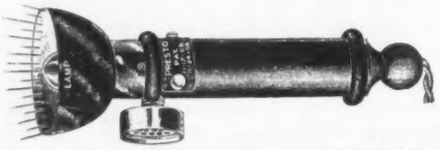


FIG. 2—COMBINATION CIGAR LIGHTER AND PORTABLE LAMP

be similarly supported or hung on a hook. The combination electric cigar lighter and portable lamp fills an important requirement on automobiles and launches.

FIG. 3—WATCHCASE-TYPE CIGAR LIGHTER

These devices operate on 6 volts and are provided with contact buttons and flexible silk cord.

Peak-Voltage Meter

As was pointed out by Mr. H. A. Morss in the *Electrical World* of July 19, 1913, it has often been observed that the ordinary voltmeter does not measure accurately the stresses to which the dielectric is subjected in the testing of insulated wires and cables. The need of an instrument which can measure any peak in the

FIG. 1—REAR VIEW OF PEAK-VOLTAGE METER

voltage-wave curve has long been recognized in connection with high-voltage testing, since it is well known that in such tests the peak of the wave is coincident with the breaking down of the insulation. The large charging current due to the electrostatic capacity of the cable tends to distort the wave-form in cable tests and makes the reading of the ordinary voltmeter unreliable.

The Simplex Wire & Cable Company, Boston, Mass., of which Mr. Morss is vice-president, has developed a device based upon the principle of the oscillograph but having its movement confined to a straight line. By means of this instrument the peak of the voltage wave

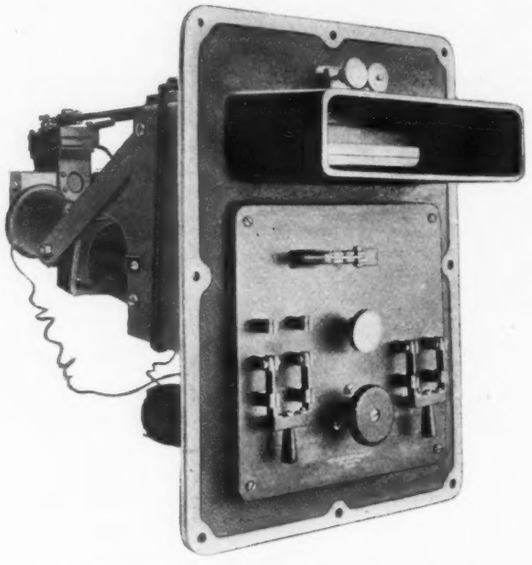


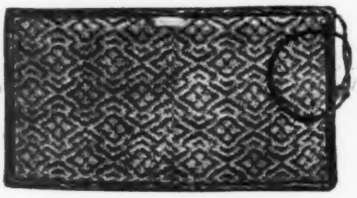
FIG. 2—FRONT VIEW OF PEAK-VOLTAGE METER

is indicated at the limit of oscillation along the line to which its movement is limited. The instrument does not show the character of the wave or the form of its peak, but it is said to give a good record of the voltage for that peak, whatever the shape of the wave may be.

The instrument, which is illustrated herewith, is of the switchboard type of voltmeter and is about 10 in. wide by 12 in. long by 14 in. deep. It consists of a heavy electromagnet, between the poles of which is placed the vibrator. By a suitable arrangement of lamp, mirror and lenses, a beam of light is thrown on a ground-glass scale in front, graduated to read volts. The instrument is connected through a potential transformer directly to the high-voltage circuit, the current being so small that the apparatus can be left in the circuit all the time. It can be quickly calibrated at any time by applying direct current of known voltage.

Electrically Heated Foot-Warmer Rugs

The foot-warmer rug illustrated herewith is the product of the Simplex Electric Heating Company,



ELECTRICALLY HEATED RUG

Cambridge, Mass. The heating element is covered with a neatly bound Wilton carpet. It can be connected to any convenient lamp socket or, if used in electric vehicles, to a suitable receptacle attached to the seat riser. The rug is 15 in. wide by 27 in. long. Its power consumption is 100 watts.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Brisk Sale of Electrical Holiday Gifts in Kansas City, Mo.—During the holiday season almost the complete stock of appliances and other electrical gifts which the Kansas City Electric Light Company had on hand was sold to an eager public. To the application of department-store methods of advertising and selling during the Christmas campaign is credited the popularity of electrical appliances. All customer purchasers were given the privilege of paying one-third cash and the balance within ninety days.

Railway Electrical Supply Manufacturer Sees Good Year Ahead.—While the present volume of business might be better the Ackley Brake & Supply Company, of 50 Church Street, New York, sees nothing acute in the present situation, and it looks forward to a good business when construction activities begin in the next quarter. Mr. Ackley is at present enjoying an extended trip through Europe, devoted mainly to pleasure, but with the idea also of looking over the situation there as a preliminary to increased sales activity abroad.

Receiver for George W. Jackson, Inc.—On petition in bankruptcy of James B. Clow & Sons, Judge Carpenter, of the United States District Court, Chicago, appointed Fred A. Busse receiver for George W. Jackson, Inc., Chicago, on Jan. 5. The receiver's bond was fixed at $5,000. Mr. Busse is a former Mayor of Chicago. The bankrupt confessed its inability to pay its debts and consented to the appointment of a receiver. It has done a large contracting business in Chicago in former years. Mr. Jackson, either as an individual contractor or as head of the corporation bearing his name, built the tunnels underlying the central part of Chicago, now operated by the Chicago Tunnel Company principally for the transportation of freight on narrow-gage railways, but also for the cables of the automatic telephone system competing with the Chicago Telephone Company. No schedule of assets and liabilities was filed at the time the application for a receiver was made.

Sub-Committees of Chicago Association of Commerce.—Sub-committees of the large and active ways and means committee of the Chicago Association of Commerce have been appointed for 1914. Subdivision No. 31, relating to "electrical goods, lighting, gas fixtures and wire," has as its chairman R. C. Fenner, of the Cutler-Hammer Manufacturing Company, the other members being H. L. Grant, vice-chairman, Western Electric Company; John A. Bennen, Thordarson Electric Manufacturing Company; Charles H. Roth, Roth Brothers & Company, and S. F. Dibble, General Electric Company. Subdivision No. 62, representing "city transportation and public utilities," is made up as follows: George B. Foster, chairman, Commonwealth Edison Company; B. S. Garvey, vice-chairman, Chicago Telephone Company; Clifford Arrick, Chicago Telephone Company; L. J. Mink, Western Union Telegraph Company; B. I. Budd, Metropolitan West Side Elevated Railway Company.

Western Electric Company's Pension Plan Gives Satisfaction.—President H. B. Thayer of the Western Electric Company issued a statement recently to the employees of the company which contained, among other things, an expression of satisfaction with the results for the past year of the operation of the employee's pension and insurance plan. He said in part: "The benefit plan has been in full operation during the year. Sickness benefits have been paid to over 500 employees and accident benefits to over 450. Fortunately, the accidents have as a rule been not of a serious nature and have involved only temporary disability. There have been twelve cases of death of those coming within the provisions of the plan, and there are fifty-three pensioners. The disbursements under the plan for the first ten months of the year were over $80,000. In many cases these payments have come in times of great necessity and have been of great relief. In all cases they have given the help in time of trouble which the company, through the benefit plan, has wanted to give."

Importers' Association Formed.—The Importers' Association of America is the official title of an organization recently incorporated in New York for the purpose of inducing co-operation between importers in every line on matters of mutual interest. Judge T. S. Sharretts has been retained by the promoters of the association as legal adviser and will have charge of its preliminary developments until a permanent executive staff and directorate have been chosen. His office at 165 Broadway, New York, is the temporary headquarters of the association. The scope of the body will be nation-wide and will include importers in every field. One of the main duties of the association will be to assist in the determination of correct market values in foreign markets in order to assist importers in the proper valuation of imports and thus reduce friction with the customs authorities. Judge Sharretts stated to an *Electrical World* representative that the association will carefully avoid affiliating itself with any political party or creed and will devote itself entirely to furthering the legitimate interests of importers, aiming toward greater uniformity and efficiency in methods.

Buckeye Engine Company Develops a New Selling Plan.—Announcement has just been made of a very novel selling plan which the Buckeye Engine Company, of Salem, Ohio, has inaugurated in connection with the merchandising of its "Buckeye-mobile." The novelty consists in embodying in the contract of sale on each engine—at the purchaser's option—a bond guaranteeing the fuel consumption of the unit. As a result of more than a year's continuous test under various conditions with various grades of fuel the company is convinced that it is safe to make a guarantee of a normal specified amount of fuel per brake-horse-power-hour, per indicated horse-power-hour, or per kilowatt-hour. The guarantee is embodied in connection with the analysis of the fuel in the contract and there is a forfeiture and bonus clause. The company agrees that upon completion of a witness test it will deduct from the purchase price as a forfeiture $1,000 for every 0.1 lb. of coal required per indicated horse-power per hour in excess of the guarantee, provided that in no case shall the amount of the forfeiture exceed the purchase price. This is on condition that the purchaser shall pay to the company, in addition to the purchase price, $100 for every 0.1 lb. of coal per indicated horse-power per hour required less than that called for by the guarantee. In event of there being a forfeiture or bonus allowance in this contract as a result of the witness test, as above provided for, then such sums shall be deducted or added, as the case may be, to the original purchase price.

J. G. White on General Conditions, Domestic and Foreign.—On Mr. White's return from abroad, about a month ago, an *Electrical World* representative called on him for some personal impressions concerning conditions in the financial and engineering fields in England and on the Continent. The following abstract is made from a statement prepared by Mr. White covering his observations along the above lines. He says in part: "On arriving in London last July general conditions there were found to be about as unfavorable as they had been in New York during the few preceding weeks. The same general conditions prevailed throughout the summer. Before sailing from England on Dec. 3 there was just beginning to be a slight hope of im-

provement, not so much as to immediate change as regarding probable improvement early in the year. Financial people generally agreed that a decided trade reaction had already set in, both in Great Britain and on the Continent. Financial conditions in Berlin had apparently improved more than in any other of the large financial centers. Regarding J. G. White & Company, Ltd., I am pleased to state that it has on hand probably as large an amount of construction work at the present time as ever before. Perhaps the largest single contract the company is now carrying out is that for the construction of a complete system of electric railways for the city of Pernambuco, Brazil, together with improvements to the gas works and telephone system and the building of a complete electric-lighting plant and distributing system for that city. Other work on hand or recently completed includes electric railway and steam railway construction in and near Buenos Aires, Argentina; a complete electric railway system for Santa Fé, Argentina; sanitation works at Para, Brazil, and other similar work. The company has recently developed a special operating or management department, and this department is now directing the general operation of a number of utility properties located all the way from Yucatan to Argentina."

Sales of Hydroelectric Equipment in Alaska.—During the past year the Westinghouse Electric & Manufacturing Company has undertaken a number of contracts for hydroelectric development in Alaska that will greatly improve mining conditions in that territory. The most important of these is the new generating unit for the Alaska Treadwell Gold Mining Company to be installed in the Hugget Creek development. This unit will consist of a 2350-kva waterwheel generator driven by a Pelton waterwheel running at 300 r.p.m. This unit will give the mining company about 3000 hp additional rating. A 50-kw motor-generator exciter set, with special shaft, so that the unit may be waterwheel-driven when desired, is also included. During the past summer the Kennecott Mines Company, operating one of the highest grade copper mines in the world, located in the Copper River district, purchased a 200-kva waterwheel generator, together with all the necessary switchboards and accessories. This water-power plant will supplement a steam-driven power plant now being operated by the mining company and containing one 400-kva generator and another generator of 50-kw rating. A considerable number of electric motors for mining and milling operations were purchased along with the other equipment. A contract has also been recently closed for a 300-kva waterwheel generator to be installed by the Chicagoff Mining Company, one of the Guggenheim interests operating near Sitka. This generator will be used to supplement the mining company's present installation rated at 127½ kw. With the generator in question there were also ordered the necessary step-up and step-down transformers for transmitting the energy at high voltage from the power plant to the mines. In addition to the above, the Alaska Juneau Gold Mining Company, of Juneau, Alaska, recently purchased from the Westinghouse company a 1012-kva waterwheel generator, to be driven by a Pelton wheel, the energy from which will be used to supplement that of a 937-kva steam turbine.

Electrical Outlook from the Underwriters' Laboratories.—A little different angle of the electrical outlook was presented to an *Electrical World* representative last week in a short talk with Dana Pierce, of the Underwriters' Laboratories, 135 William Street, New York. Mr. Pierce touched upon a number of interesting points. Concerning the business handled by the laboratories during the past year, he said that for the first six months it was about normal in both quantity and variety. During the latter part of the year there has been a decrease in quantity and a tendency toward the more standard lines, little new in the line of apparatus or supplies being handled. The label service is in good demand. One of the very favorable tendencies of the past year, according to Mr. Pierce, is the great improvement in the quality of the wire manufactured under the new code specifications. Agitation to the end of an improvement in the quality of wire for electrical uses was begun some time ago, and the actual manufacture of a better grade of wire was only started on a large scale during the past year. The improvement which has been made in the short space of one year was characterized by Mr. Pierce as nothing short of marvelous, and, with the present standard in view, he said that it was hard to believe that the old specifications could have been tolerated. The same tendency toward standardization has been in evidence to less degree in other electrical materials and equipment during 1913. An interesting question was recently put up to the Laboratories by British manufacturers, and the step taken to solve it is full of significance, as indicating how political border lines are destined to break down with the progress of business expansion. The National Electrical Code is standard in a large part of Canada. It differs radically from the specifications to which British electrical manufacturers work; in fact, in England there is no universal standard in these matters. The result has been that the products of such manufacturers have often been imported into Canada and then found to fall short of the specifications there recognized. To correct this difficulty the Laboratories were asked to establish a branch in London and extend their service to all who wish to take advantage of it, and this has been done. Similar, though less insistent, demands have been made for branches in other European countries. Perhaps the outcome might be international standardization, along the same lines that have been found so effective in the United States. Mr. Pierce spoke specially of the 1913 electrical code for New York City, just issued, and gave it as his opinion that the revision of that code to very nearly approximate the National Electrical Code is a decided step toward general efficiency and sets a precedent that might well be followed by other cities large and small.

Where American Electrical Exports Go.—The following table, summarizing the geographical distribution of American electrical exports for the year July 1, 1912, to June 30, 1913, inclusive, was obtained from the New York office of the Bureau of Foreign and Domestic Commerce:

Item	Distribution					
	Europe	N. Amer.	S. Amer.	Asia	Oceanica	Africa
Generators:						
Value ...	$459,668	1,022,847	272,615	873,781	135,456	9,040
Fans:						
Number .	2,068	14,129	6,864	5,821	1,089	286
Value ..	$25,627	148,141	82,101	85,338	14,529	3,048
Arc Lamps:						
Number .	339	5,940	3,426	176	134	2
Value ...	$8,141	107,613	63,546	3,660	2,970	89
Carbon-filament Lamps:						
Number .	151,684	972,527	327,116	32,111	37,965	6,017
Value ...	$17,040	148,073	48,144	7,061	6,922	1,048
Metallic-filament Lamps:						
Number .	36,599	513,244	519,895	10,408	190,650	92,697
Value ...	$12,547	175,616	134,833	3,336	48,176	20,184
Motors:						
Value ...	$367,276	1,898,971	590,320	540,193	319,401	81,756
Telegraph Instruments:						
Value ...	$6,024	131,999	54,264	5,197	17,563	58
Telephone Instruments:						
Value	237,970	918,135	144,436	41,940	28,539	626
Miscellaneous:						
Value .	$1,861,701	9,152,807	3,374,118	1,546,092	1,218,696	293,647
Total:						
Value .	$2,995,994	13,704,202	4,764,377	3,106,598	1,792,252	409,496

NEW YORK METAL MARKET PRICES

	Dec. 29		Jan. 6	
	Bid	Asked	Bid	Asked
Copper:				
Standard, spot*	14.37½ to 14.87½		.....	.....
	Selling prices		Selling prices	
	£ s. d.		£ s. d.	
London, standard, spot* ..	66 6 3		64 3 9	
Prime Lake	15.25	to 15.50	15.00	.....
Electrolytic	14.75	to 15.00	14.25	to 14.62½
Casting	14.50	to 14.62½	14.25	to 14.50
Copper wire base	16.00	.....	15.75	.....
Lead		4.15		4.15
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f.o.b. smelter ..		7.25		7.50
Spelter, spot	5.30	to 5.35	5.25	to 5.35
Tin, spot	37.62½	to 37.87½	36.77½	to 37.12½
Aluminum:				
Prompt delivery	18.50	to 19.00	18.50	to 19.00
Future	18.50	to 19.00	18.25	to 18.75

***COPPER EXPORTS**

Heavy copper and wire	13.50	13.50
Brass, heavy	8.75	8.75
Brass, light	7.75	7.75
Lead, heavy	4.05	4.05
Zinc, scrap	4.37½	4.25

***OLD METALS**

Total tons to Jan. 6 3,592

*From daily transactions on the New York Metal Exchange.

Corporate and Financial

Merger of Virginia Utilities Planned.—Meetings of the stockholders of the Citizens' Railway, Light & Power Company, the Newport News & Old Point Railway & Electric Company and the Hampton Roads Traction Company were called for Jan. 9 to approve a plan for merging the companies under the name of the Newport News & Hampton Railway Gas & Electric Company.

Ohio Utility Changes Dividend Plan.—The directors of the Northern Ohio Traction & Light Company have given notice of a change in their policy concerning the declaring of dividends. Hereafter, instead of making the declaration for the entire year payable quarterly, the dividends will be declared quarterly. The February dividend of 1¼ per cent will be paid the same as last year.

Chicago Subway Fails to Get Bids.—On Jan. 5, the day on which bids for the construction of the proposed new Chicago subways were to be opened, it was found that no bids had been received. The city plans to give a twenty-year franchise to the builder, who will be paid for the construction out of earnings in that portion of the twenty-year period remaining after the lines are completed. Evidently this proposition did not look attractive to prospective contractors.

Service Pension Plan Adopted on Insull Property.—The Public Service Company of Northern Illinois, one of the Insull properties, has just decided upon a service pension plan for the payment of annuities to employees who have served a certain number of years with that company or any of its subsidiaries. The plan goes into effect in March, 1917. The annuities will be paid according to three classifications, taking into consideration the age of the applicant and the length of time in the company's service, and a minimum annual pension of $300 is proposed. The plan is modeled after that of the Commonwealth Edison Company of Chicago.

Standard Underground Cable Declares Extra Dividend.—The Standard Underground Cable Company, of Pittsburgh, Pa., has declared an extra dividend of 3 per cent in addition to the regular quarterly 3 per cent dividend on its $3,500,000 outstanding capital stock. The dividend record of this company is interesting. Organized in 1889, its first dividend in 1890 was 3 per cent. The rates paid in the succeeding years were: 1891, 6½ per cent; 1893 and 1894, 6 per cent each; 1895, 7 per cent; 1896, 8 per cent; 1897, 6½ per cent; 1898 and 1899, 8 per cent each; 1900, 1901 and 1902, 10 per cent each; 1903, 1904 and 1905, 12 per cent each; 1906, 17 per cent; 1907, 15 per cent; 1908, 22 per cent; 1909, 29 per cent; 1910, 20 per cent, including an extra dividend out of earnings for 1910 and a special 5 per cent dividend out of earnings of previous years; 1911, 15 per cent; 1912, 15 per cent, including 3 per cent extra in January. Last January the extra 3 per cent dividend was declared also. The date of the present payment is Jan. 10.

Industrial Board Recommended for "Unscrambling" Big Business.—In an address before the Illinois Manufacturers' Association at Chicago on Jan. 5 Samuel Untermyer advocated an industrial commission to act in the breaking up of trusts and the regulating of corporations. He stated that the machinery of the courts is not adapted to the disintegration of outlaw corporations, which must be not only unscrambled but kept unscrambled. Among the changes advocated by Mr. Untermyer were the prohibition of interlocking staffs and directorates, the abolition of the usual form of holding company, the prohibition of stock watering, the disclosure of profits from the sale of securities, the requirement of cumulative voting in order to secure minority representation on directorates, the abolition of voting trusts, the prevention of fiscal agency contracts, the prohibition of deposits of interstate corporations in private banks, the incorporation of the stock exchanges and clearing houses, and the prevention of the migration of corporations into states offering illegitimate inducements in the form of lax corporation laws.

Morgan Firm Withdraws from Many Directorates.—The financial world was surprised last week by the announcement of the withdrawal of the members of the firm of J. P. Morgan & Company from directorships in many large industrial, financial and public utility concerns. In all, about thirty large companies are affected by the action of the Morgan company, and the three largest are the New York Central System, the New York, New Haven & Hartford Railroad Company and the American Telephone & Telegraph Company. The Western Union Telegraph Company and the Westinghouse Electric & Manufacturing Company are also on the list of the companies affected by this action. A statement issued by J. P. Morgan, explaining the motives of himself and his associates in resigning from these directorates, seems to imply that the move has been under consideration for some time and is the result of an apparent growing public sentiment against the interlocking directorate system and its abuses. G. F. Baker, chairman of the board of directors of the First National Bank of New York City, when interviewed concerning the action of the Morgan interests, stated that he had desired to do the same thing for some time and would resign from a number of directorates as soon as it became possible. It will be a matter of interest to see what plan of control will be substituted for the one abandoned and to what extent other financial interests will follow the example set.

Alleged Manipulation of Central Union Telephone Company.—Certain minority stockholders in the Central Union Telephone Company have brought suit against the American Telephone & Telegraph Company, Theodore N. Vail, B. E. Sunny, Union N. Bethell, L. G. Richardson and other officers of the parent Bell company or subsidiary companies. The plaintiffs allege that the defendants have been "milking" the Central Union company and urge the naming of a receiver to protect their interests. The case was brought in Chicago before Judge W. E. Dever, of the Superior Court of Cook County, with an opposing array of counsel. It is said that the capital stock of the Central Union Company is $5,450,927, of which the American Telephone & Telegraph Company owns $5,204,977.50. The dissatisfied stockholders are said to own about $100,000 worth of the stock of the company. It is charged that three years ago the company had no deficit, but that although its gross annual income is about $7,000,000, a deficit is now rolling up at the rate of $300,000 a month. The parent Bell company says that it loaned the Central Union about $35,000,000, and the interest charges on this sum, together with the money borrowed, have placed the Central Union company in its present plight, according to the complainants. The Central Union operates in parts of Illinois, Indiana and Ohio. Many letters have been read into the record of the case. They are alleged to have passed between Mr. Sunny (president of the Chicago Telephone Company, and also of the Central Union and other operating companies), Mr. F. P. Fish, former president of the American Telephone & Telegraph Company; Mr. Vail, the present president; Mr. F. A. Pickernell, Mr. L. G. Richardson, former president of the Central Union, and others. The lawyers for the petitioning stockholders tried to prove that the officers of the Central Union company conducted a continuous campaign to force down the price of the stock by refusing to declare dividends and thereby to enable the American Telephone & Telegraph Company to buy up the outstanding shares at a low figure. Some of the letters are of considerable interest. One, alleged to be written by Mr. B. E. Sunny to Mr. Theodore N. Vail, under date of July 23, 1913, is said by the newspapers to contain the following: "It is not so much a question of trying to conduct the business in a progressive way and without offending the Sherman act as it is meeting the demands from every quarter for a single telephone system and first-class service. The public demand is first and the Sherman act is second, for the reason that what is asked for now is the last expression of the people." Attorneys for the defendants have presented a number of affidavits tending to refute the charges of the minority stockholders that business was systematically diverted from the lines of the Central Union to those of the American Telephone & Telegraph. These affidavits gave a detailed explanation of the diversion of business from one company to the other. It is contended that the letters read into the record on the part of the complainants make only a partial showing of the case and fail to incorporate answers or replies that would have dissipated the idea of unfairness.

Business Notes

Alfred F. Moore, of Philadelphia, Pa., manufacturer of insulated wire, is now represented in Chicago territory by E. P. Bartlett, 1368 Grand Avenue, where a complete stock is carried for the convenience of customers.

The Steel City Electric Company, of Pittsburgh, Pa., has announced the appointment of the G. A. Schardt Company, of the same place, as its sales representative in West Virginia and in the section of Pennsylvania west of Altoona.

The "Exide" Battey Depots, Inc., of Atlanta, Ga., has been forced by its increase of business to seek larger quarters, and after Jan. 1 it will occupy the warehouse of the Georgia Railway & Power Company, at 20 Piedmont Avenue.

The Barber-Dwinnell Electric & Manufacturing Company, of Kansas City, Mo., announces that it has been granted a charter under the laws of that State and has augmented its working capital, retaining, however, the personnel and policies of the old organization.

The Doubleday-Hill Electric Company, of Pittsburgh, Pa., has just purchased a building at 727 Twelfth Street, Washington, D. C., where it proposes to open shortly a large Eastern branch, affording it greater facilities for rendering quick service to its customers in that territory.

The International Engineering Corporation, Ltd., of 49 Exchange Place, New York City, has been formed for the purpose of carrying on engineering work in the United States, Canada, Central America and South America. Its officers are J. W. Burke, president, T. C. Gillespie, vice-president; H. P. Du Boise, secretary; H. M. Lloyd, treasurer.

The Monitor Controller Company, of Baltimore, Md., has moved its Philadelphia office to Suite 823, Drexel Building. After Jan. 1, 1914, the Boston office of the same concern will be under the supervision of the Tompkins-Stoddard Company, of 77 Franklin Street. Mr. Stoddard, of that firm, was formerly Boston representative of the Monitor company.

The K & B Company, formerly at Eighth and Chestnut Streets, Philadelphia, Pa., has moved to 25 North Seventh Street, where it has increased facilities and will handle special electrical supplies and mechanical devices. It has recently been appointed Philadelphia agent for the Union Metal Manufacturing Company on that concern's line of street-lighting standards.

The Robbins & Myers Company, of Springfield, Ohio, has made a number of organization changes recently. The St. Louis (Mo.) office of the company is now located at 1515 Chemical Building, and is in charge of I. Elkas. A. S. Chamberlain has lately assumed the direction of the company's New York office. A branch office has been opened in Cleveland, Ohio, under the management of A. J. Reed. The Cincinnati (Ohio) office is now at 9 East Third Street, and G. H. Liebel is in charge.

New Industrial Companies

Maysmith & Lowe, of Victoria, B. C., Can., have been incorporated with a capital stock of $10,000 to do a general electrical and mechanical engineering and contracting business.

The Klingelsmith Electric Truck Company, of Chicago, Ill., has been incorporated by Joseph M. Klingelsmith, Michael M. Cure and Earle F. Tilley. The company is capitalized at $350,000 to manufacture electric vehicles.

The Electric Construction Company, of Chicago, Ill., has been incorporated with a capital stock of $10,000 to do a general electrical contracting and manufacturing business. The incorporators are Christopher C. Buckels, George Homer Hightower and Ernest Cooley.

The Held Company has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $150,000 and purposes to manufacture and sell scientific, electrical and medicinal instruments. The incorporators are H. E. Latter, W. J. Maloney and O. J. Reichard, of Wilmington, Del.

Trade Publications

Guy Anchors.—A folder has recently been issued by W. N. Matthews & Brother, St. Louis, Mo., which briefly describes and illustrates how 20 per cent of the cost of storm anchors can be saved by the use of Matthews guy anchors.

Electricity in Iron Foundries.—Bulletin A4167 of the General Electric Company is devoted to the subject of electricity in iron foundries. The bulletin is fully illustrated with some typical applications of motors in iron foundries and contains a chapter on foundry lighting.

Electric Furnaces.—Bulletin No. 8 of the Hoskins Manufacturing Company, 453 Lawton Avenue, Detroit, Mich., refers to electric furnaces. Made in muffle, tube and crucible chamber designs and in a number of sizes, adapted to a wide variety of uses. The bulletin contains twenty pages and is fully illustrated.

Regulator for Street Lighting.—The Electric Appliance Company, Chicago, in Bulletin No. 202, refers to the "A-W" regulator for street lighting, a device designed to maintain a constant current on a series tungsten lamp circuit. Illustrations are given showing the constructive features of the device and diagrams of connections. A description of the device is presented and the method of installing it outlined. The bulletin contains also two full-page illustrations showing series lamps controlled by "A-W" regulators in two cities.

Heating Appliances.—Electric household appliances for cooking and miscellaneous purposes are illustrated and described in Catalog No. 18 issued by the Simplex Electric Heating Company, Cambridge, Mass. The index to the contents of this catalog indicates a surprisingly large variety of these devices, and the illustrations show many artistic designs. A separate leaflet is addressed to dealers urging them to take advantage of the increased demand for electrical Christmas gifts and illustrating some of the advertisements in the leading magazines advertising Simplex specialties.

Electric Furnaces.—Bulletin 1026 of the Metallurgic Engineering Company, 53 West Jackson Boulevard, Chicago, Ill., relates to the Snyder system electric furnace. This furnace is designed for convenience of operation under American foundry conditions. A description of the furnace, its characteristics and quality, together with a reference to tilting and control, is given. A table is included giving approximate costs of melting steel in a Snyder system electric furnace in the Middle West for the usual range of tonnage for twenty-four hour and twelve-hour operation. The system is available for either alternating current or direct current, single-phase or three-phase operation at 60 cycles or 25 cycles.

Fire Extinguishers.—The Pyrene Manufacturing Company, 1358 Broadway, New York, has issued a trade circular containing the announcement of an advertising campaign of Pyrene extinguishers which has been directed to 15,000,000 readers. Fac-similes in colors of the covers of the leading popular and technical magazines in which Pyrene advertisements appear afford an effective suggestion of the wide newspaper publicity given to these fire extinguishers. Across the top and across the bottom of pages showing sample advertisements of this device are pertinent paragraphs addressed to dealers, to whom this opportunity to handle the Pyrene fire extinguisher and benefit by the national advertising is offered.

Illumination Computer.—The Engineering Department of the National Lamp Works of the General Electric Company, Cleveland, Ohio, has prepared an ingenious "illumination calculator" in the form of a circular celluloid slide rule for computing the spacing of lamps to give any desired intensity. To use the computer the intensity required is first determined from a table on the back of the card, the "utilization factor" being meanwhile read from a second set of data. Setting these values opposite each other, one reads, just below the size of lamp, figures showing the required spacing and height above the floor for the reflector selected. The scale is graduated in terms of lumens per lamp and is correct for "Mazda" lamp efficiencies now standard.

Personal Mention

Mr. Roy Baldridge, of Macomb, Ill., has been made manager for the Central Illinois Public Service Company at Plymouth, Ill.

Mr. W. E. McFadden, for some time manager of the Salina (Kan.) Light, Power & Gas Company, has resigned and removed to Nebraska.

Mr. Harry J. Frith has resigned his position as district manager for the Central Illinois Utilities Company, with headquarters at Watseka, Ill.

Mr. T. P. Alston has resigned as general manager of the St. John's Light & Power Company, of St. Augustine, Fla., and the office of general manager has been abolished.

Mr. F. Kumpf, manager of the light and water utilities of Waterloo, Ont., has been appointed by the Hydro-Electric Power Commission of Ontario to a position in Ottawa.

Mr. B. F. Wood, formerly assistant engineer of the Pennsylvania Railroad, has been appointed chief engineer of the United Gas & Electric Engineering Corporation, of New York City.

Mr. George H. Caffery, former manager of the United Electric Light & Water Company, of Norwalk, Conn., has accepted a position as superintendent of an electric-light plant in Texas.

Mr. J. Sanger, formerly superintendent of distribution for the Winnipeg municipal electric-light plant, has accepted a position with the Winnipeg branch of the Siemens Company of Canada, Ltd.

Mr. Henry Heick, vice-president of the electrical supply and contracting concern of Albrecht & Heick, Louisville, Ky., has retired after a connection with the business extending over twenty-seven years.

Mr. W. H. Timm, formerly connected with the Wisconsin Railroad Commission at Madison, Wis., has been appointed assistant secretary of the Public Service Commission of New Hampshire as successor to Mr. F. E. Webster.

Mr. Frederick E. Webster has resigned as assistant secretary of the Public Service Commission of New Hampshire and accepted the position of treasurer and auditor of the Rockingham County Light & Power Company, Portsmouth, N. H.

Mr. Frank W. Harvey, Jr., Chicago, business manager of *Popular Electricity and the World's Advance*, has been appointed alternate statesman of the Jovian Order for Illinois, succeeding Mr. E. H. Waddington, resigned owing to removal from Chicago.

Mr. Gaylord Buck, who has been connected with the new-business department of the Citizens' Gas, Electric & Heating Company, of Mount Vernon, Ill., for the past eighteen months, has been appointed commercial manager, succeeding Mr. W. P. Guinau.

Mr. T. H. Aldrich, supervising engineer for the National X-Ray Reflector Company, gave an illustrated address on "Present-Day Practice in Interior Lighting" before the Chicago Jovian League on Jan. 5. He dwelt on the necessity of concealing light sources.

Mr. J. S. Kennedy, for many years secretary of the Public Service Commission, Second District, New York, has been appointed secretary to the employees' benefit fund committee having in charge the welfare of 45,000 telephone employees of the Bell system in the East.

Mr. W. P. Guinau, who has been commercial manager of the Citizens' Gas, Electric & Heating Company, of Mount Vernon, Ill., for the past two years, has been transferred to be commercial manager of the Danbury (Conn.) Gas & Electric Company, which is controlled by the same company.

Mr. John F. Wessel, general manager of the Mahoning & Shenango Railway & Light Company, Youngstown, Ohio, a subsidiary of the Republic Railway & Light Company, has returned to New York to take up duties with the latter corporation. The office of general manager has been abolished.

Mr. J. B. Sunderland has severed his connection with the British Columbia Electric Railway Company, Ltd., of Vancouver, B. C., with which he has been connected for the past five years. He has taken charge of the agency department of Messrs. McDonald, Marpole & Company, of Vancouver, B. C.

Mr. A. D. Mackie, who has been sales manager in Detroit for Hodenpyl, Hardy & Company, bankers, of New York, has been appointed general manager of the Union Railway, Gas & Electric Company, Springfield, Ill., as successor to Mr. A. D. Furlong, who has been transferred to Saginaw and Bay City, Mich.

Mr. Thomas J. Lyons, who severed his connection with the Blackstone Valley Gas & Electric Company of Woonsocket, R. I., was presented by the employees of the company with a gold chain and charm set with diamonds on Dec. 27. Mr. Lyons has accepted a position with the Michigan Stove Company, with headquarters at Binghamton, N. Y.

Mr. Frank G. Baum was guest of honor at a dinner given by the Pacific Gas & Electric Company, Dec. 19, in celebration of the completion of the Lake Spaulding dam and Beaver River power plant, both of which were constructed under his supervision. The dinner was given at the St. Francis Hotel, San Francisco, and was attended by 200 persons.

Mr. Ernest Gonzenbach has resigned as president and general manager of the Sheboygan (Wis.) Railway & Electric Company, following the sale of the controlling interest in the company to local interests in Sheboygan. Mr. Gonzenbach intends for the present to devote himself to the further development of a fruit and dairy farm on which he has lived for several years.

Mr. Roger W. Babson, Wellesley Hills, Mass., was the principal speaker at a dinner given by the Jovian Club of Minneapolis at the Hotel Radisson on Dec. 30. Mr. Babson had been attending the convention of the American Economic Association, and the electrical men took advantage of the occasion to get him to talk to them on finance, labor and international peace.

Obituary

David G. Mouat, purchasing agent for the Lindstrom-Smith Company, of Chicago, manufacturer of electrical specialties, died suddenly on Jan. 3.

Bernard Corrigan, who was president of the Kansas City (Mo.) Railway & Light Company from 1902 to 1911, died of heart disease in that city on Jan. 6, after a few hours' illness.

Zero Marx, founder of the Zero Marx Sign Works, and a pioneer in the manufacture of electric signs in Chicago, died in St. Mary's Hospital, Rochester, Minn., on Dec. 31. The cause of death was uremic poisoning.

W. E. Davidson, secretary of the Pearson Mexican corporations, having offices in Toronto, Ont., and which include the Mexican Light & Power Company, the Mexican Tramways Company and the Mexican Northwestern Railway Company, died on a steamer in the Gulf of Mexico on Christmas Day.

William D. Marks, well known as a consulting engineer, died at Plattsburg, N. Y., on Jan. 7. Professor Marks was born in St. Louis Feb. 26, 1849, and was graduated from Yale in 1870 with the degree of Ph.B. He specialized in civil and mechanical engineering and later received his C. E. degree from the same college. After leaving Yale he engaged in practical engineering work in connection with railways and gas and iron works. In 1876 he became instructor in mechanical engineering at the Lehigh University and the following year became associated with the University of Pennsylvania as Whitney professor in engineering. He was superintendent, in 1884, of the International Electrical Exhibition of the Franklin Institute, and later became engineer and president of the then Edison Electric Light Company of Philadelphia. Professor Marks was an honorary life member of the Franklin Institute, a full member of the American Institute of Electrical Engineers and a member of the American Philosophical Society. He was the author of several books and of many scientific papers and reports.

Construction

New England

CHERRYFIELD, MAINE.—The Cherryfield El. Lt. Co. may purchase within the next 12 months a new waterwheel. E. S. Nash is superintendent.

HIRAM, MAINE.—Development of the water-power on the Saco River at Highland Ripps, between Limington and Baldwin, or at Allens Falls on the Little Ossipee, between Cornish and Hiram, or both, is under consideration by the Baldwin & Hiram Lt. & Pwr. Co. The company is securing options and purchasing land on both sides of these rivers. J. Merrill Lord, of Parsonsfield, is interested in the company.

BOSTON, MASS.—A bill has been filed by Representative Beck, of Chelsea, in the State Legislature asking that authority be given to the Metropolitan Park Commissioners to expend $500,000 for the construction of an electric-light plant for the purpose of furnishing electricity to maintain lamps on parkways under their direction.

BOXFORD, MASS.—The Lawrence Gas Co., of Lawrence, has applied to the State Board of Gas and Electric Light Commissioners for permission to supply electricity for lamps, heaters and motors in Boxford.

NORTH ATTLEBORO, MASS.—Within the next three months the Electric Light and Water Department expects to erect a fireproof storage warehouse (concrete and steel construction) to replace the one destroyed by fire three months ago: also within the next six months to reconstruct boiler room (fireproof) and install a new 150-hp boiler.

PITTSFIELD, MASS.—The committee appointed by the Board of Alderman to investigate the advisability of purchasing the plant of the Pittsfield El. Co., to be owned and operated by the municipality, submitted its report on Dec. 15 to the board. The committee does not advise the purchase of the plant by the city at the present time or any time in the near future.

WORCESTER, MASS.—Locations for 389 lamps that are to be installed on the streets of Worcester under the proposed new street-lighting system have been designated by Henry A. Knight, superintendent of light and wires. The original estimate called for 307 6.6-amp luminous-arc lamps, but the revised list to be considered by the Council calls for 289 lamps. The City Council has accepted the report of the committee on lighting streets, recommending the relocation of 77 arc lamps in the outskirts of the city. The Worcester El. Lt. Co. has the contract for street-lighting.

VALLEY FALLS, R. I.—The town of Cumberland has entered into a contract with the Blackstone Valley Gas & El. Lt. Co. for a period of ten years which provides for an all-night lighting service and the installation of new lamps. The company is planning to install 160-cp lamps on Board Street as soon as possible.

BRIDGEPORT, CONN.—The lamps committee of the Board of Aldermen will ask the Board of Apportionment for an appropriation of $89,538 and for $16,000, the latter to be used for the installation and maintenance of the proposed ornamental street-lighting system. The plans provide for 118 additional arc lamps.

TORRINGTON, CONN.—The Torrington El. Lt. Co. has awarded the contract for the construction of a new substation and power plant (34 ft. by 57 ft.); brick and concrete construction.

Middle Atlantic

ALBANY, N. Y.—Bids will be received by the Trustees of Public Building, Capitol, Albany, N. Y., until Jan. 20, for electric wiring of the west wing of the State Capitol Building, Albany. Drawings and specifications may be consulted and blank forms of proposals obtained at the office of Lewis F. Pilcher, state architect, Capitol, Albany.

ALBANY, N. Y.—Bids will be received at the office of the clerk of Board of Supervisors, City Hall, Albany, until Feb. 4 for furnishing and installing complete as follows: (1) Electric wiring for lamps and motors, conduits for telephones, watchman's clock system, fire-alarm system, wiring for time-clocks and miscellaneous bell work; (2) time-clock system; (3) electric passenger elevators, all for the new court house for the county of Albany, to be built on Columbia Street between Lodge and Eagle Streets. Plans and specifications may be seen at the office of the clerk of the board, City Hall, Albany, or at the office of Hoppin & Koen, architects, 244 Fifth Avenue, New York; also at the office of V. C. Wynne, consulting electrical engineer, 86 State Street, Albany. Copies of plans and specifications may be obtained upon application to the architects.

BROOKLYN, N. Y.—Bids will be received by R. A. C. Smith, commissioner of docks, Department of Docks and Ferries, Pier A, foot of Battery Place, North River, New York, until Jan. 15, for furnishing under contract (No. 1399) all labor and material required for installing electric-lighting fixtures at the Thirty-ninth Street Ferry terminal, borough of Brooklyn. Blank forms and further information may be seen at the office of the department.

SYRACUSE, N. Y.—The ordinance providing for the ornamental-lighting district passed by the City Council has been signed by Mayor Schoeneck. By the terms of the new ordinance the number of lamps will be increased to 593, making an addition of 378 lamps.

SYRACUSE, N. Y.—Bids will be received by the trustees of the New York State College of Forestry, Syracuse University, Syracuse, until Jan. 27, for construction, heating and ventilating, plumbing and gas-fitting and electric work for the New York State College of Forestry, Syracuse University, Syracuse. Bids will be for each division of the work separately and no combination of bids will be considered. Drawings and specifications may be consulted and blank forms of proposals obtained at the office of the dean of the New York State College of Forestry at Syracuse University, Syracuse, and at the office of Lewis F. Pilcher, state architect, Capitol, Albany, where complete sets of plans and specifications may be obtained.

WARSAW, N. Y.—Arrangements have been made by the Warsaw Gas & El. Co. with the village to remove all overhead wires on Main Street in the business section and place them in underground conduits for the purpose of furnishing electricity to maintain the lamps on the new standards. The company is to remove the poles and place the wires in conduits at its own expense, the village furnishing the lamps and standards.

BANGOR, PA.—The Industrial El. Lt. Co., to which a franchise to furnish electrical service in Bangor was recently granted, will secure electricity from the Lehigh Coal & Navigation Co. Wires will be strung on the poles of the Blue Mountain Tel. Co. A transformer station will be erected in Bangor. As yet definite arrangements for installing the system have not been made. D. M. Hambright, of Bangor, is engineer in charge and E. G. Markley is secretary.

LEBANON, PA.—The Lebanon Valley El. Lt. Co. has been granted a franchise to furnish electricity in the city of Lebanon for a period of 50 years. The franchise provides for a minimum bid for street lighting at $65 per lamp per year.

MAUCH CHUNK, PA.—The power house of the Mauch Chunk Ht., Pwr. & El. Lt. Co. was destroyed by fire on Dec. 27, causing a loss of about $80,000. The Mauch Chunk company has entered into contract with the Lehigh Coal & Navigation Co., of Philadelphia, to furnish electricity for one year. For the present the service will be supplied from Harwood, via Hauto and Nesquehoning. A new wire will be erected between Nesquehoning and Mauch Chunk.

MONTROSE, PA.—The property of the Montrose El. Lt., Ht. & Pwr. Co. has been purchased by the Susquehanna & Lanesboro Ht. & Lt. Co., of New Milford. The new company, it is understood, proposes to make extensions to the system. The local plant will be used to supply electricity between Susquehanna and New Milford.

PHILADELPHIA, PA.—C. E. Schermerhorn has completed plans and has invited bids on the electrical installations for the church and Sunday-school building for the First Baptist Church.

PHILADELPHIA, PA.—The contract for the installation of the entire electrical equipment, including the wiring for lamps and motors, in the new building of the Ford Motor Car Co. at Broad Street and Lehigh Avenue, Philadelphia, has been awarded to the United El. Construction Co., 1727 Sansom Street, Philadelphia. The building is 231 ft. by 312 ft. and is ten stories high. The cost of the electrical work is estimated at about $200,000.

PITTSBURGH, PA.—The Duquesne Lt. Co., of Pittsburgh, is planning to erect a new substation on Warrenton Avenue, near the Mount Washington tunnel. The building will be 114 ft. by 46 ft., one story and basement and of brick and concrete construction.

PITTSBURGH, PA.—Twenty-six companies chartered for the Ohio and Beaver Valleys have been merged into the Harmon El. Co. with a capital stock of $130,000. The directors are: William McBride, of Sewickley; D. C. Wiseman, of Bellevue; T. L. Bedell, of McKeesport, and C. H. Walsh, of Pittsburgh.

PITTSBURGH, PA.—One hundred and sixty-two electric companies chartered for southwestern Pennsylvania companies within the last 18 months have filed notices of merger into four corporations, each headed by W. S. Kuhn, of J. S. & W. S. Kuhn, Inc., of Pittsburgh. Of the above companies, 100 have been merged into the West Penn Ltg. Co., capitalized at $547,000; 39 into the West Penn Lt. & Pwr. Co., with a capital stock of $244,000; 16 into the West Penn El. Co., capitalized at $901,000, and seven into the Kittanning El. Co., with a capital stock of $51,000. The first three companies will have offices in Pittsburgh and the latter in Kittanning. The directors of all four companies are as follows: W. S. Kuhn, J. B. Van Wagener, Byron Trimble and J. A. Lynch, of Pittsburgh, and C. W. Scheieck, of Mount Lebanon.

SCRANTON, PA.—The Scranton El. Co. will erect a substation in Moosic to furnish electricity to the Scranton Ry. Co. to operate its cars in that section. At present the electric company is using two substation cars of the Scranton, Dunmore & Moosic Lake R. R. Co., pending the construction of the station. Frank Caum is general manager of the Scranton Railway Co.

WASHINGTON, PA.—Burgess W. W. Hoyt has vetoed the ordinance passed by the Council granting a franchise to the Relief El. Lt., Ht. & Pwr. Co.

BOONTON, N. J.—The Board of Utility Commissioners has approved the ordinance granting the Boonton, El. Co. permission to erect distribution lines in the streets of Boonton Township.

FREEHOLD, N. J.—The Board of Public Utility Commissioners has granted the Monmouth Lt. Co., of Freehold, permission to issue securities to the amount of $6,400, the proceeds to be used for extensions in its system in Marlboro, Englishtown and vicinity.

HADDONFIELD, N. J.—Allen Clymer, borough clerk, writes that no proceedings are yet under way for a municipal electric-light plant in Haddonfield.

JERSEY CITY, N. J.—The Board of Freeholders is considering the installation of ornamental iron poles in connection with the street-lighting system along the county boulevard.

LODI, N. J.—Bids will be received by the Board of Education until Jan. 14 for the construction of a 13-room school building, including electrical work, heating and ventilating. Anton L. Vegliante, of Garfield, is architect.

MORRISTOWN, N. J.—The Morris County Trac. Co. is contemplating the construction of a power plant in Morristown, to cost about $250,000. O. G. Schultze, of Morristown, is secretary and treasurer.

NEWARK, N. J.—The Public Utility Commissioners of New Jersey have granted the Pub. Ser. El. Co., subject to certain conditions, permission to issue $3,000,000 in capital stock, the proceeds to be used for improvements and extensions to its system.

HARPERS FERRY, W. VA.—The Harpers Ferry El. Lt. & Pwr. Co. is contemplating enlarging its power plant with a view of extending its service. George R. Bready is secretary and manager.

MARTINSBURG, W. VA.—The Martinsburg Pwr. Co. has filed a mortgage with the Safe Deposit & Trust Co. of Baltimore, as trustee, to secure an issue of $5,000,000 in bonds. The securities, it is said, will be issued as needs require. The company has plans under way for enlarging its central power plant in order to supply electricity to operate the new electric railway in Martinsburg.

BOYCE, VA.—Arrangements are being made by the town of Boyce to install a municipal electric-light plant. It is proposed to build a hydroelectric plant, for which surveys have been made by F. L. Robeson, of Virginia Polytechnic Institute, Blacksburg. The town has already purchased a 90-kw alternator and will purchase an engine to operate the generator until the water-power is developed.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Jan. 20 for furnishing at the various navy yards and naval stations the following supplies: Portsmouth, N. H., Schedule 6223—one 25-kw turbo-driven generator. Brooklyn, N. Y., Schedule 6212—255 miscellaneous opal, heat-resisting inner globes; Schedule 6222—eight electric air heaters for ships; 1600 ft. single-conductor, armored wire, Navy standard; Schedule

6221—miscellaneous spares for electric ranges and ovens; Schedule 6214—15,000 lb. calcium carbide in 100-lb. metal drums. Boston, Mass., Schedule 6204—renewing storage batteries for motor trucks; Schedule 6211—14,000 lb. galvanized, cast-steel crucible wire, 3000 lb. galvanized soft steel wire; Schedule 6217—3800 lb. of chloride of calcium. Newport, R. I., Schedule 6220—1350 lb. miscellaneous hard-drawn copper tubing. Bids will also be received at the same place until Jan. 27 for furnishing at the navy yard, Mare Island, Cal., the following: Schedule 6201—600 lb. electrolyte acid in carboys and 5000 lb. of carbide calcium in 100-lb. drums. Bids will also be received until Feb. 10 for furnishing at the navy yard, Brooklyn, two 5-kw radio sets for ship installation as per schedule 6196. Applications for schedule should designate the schedule desired by number. T. J. Cowie is paymaster general, U. S. N.

North Central

BATTLE CREEK, MICH.—The city commission has decided to expend $4,500 on electric-lighting fixtures for the new city hall, bids for which will be received until Jan. 19. Bids will also be received on an electric elevator.

DETROIT, MICH.—The Ford Motor Co., of Detroit, is planning extensive additions to its power plant during the coming year, involving an expenditure of about $1,000,000. A new building will be erected in the rear of the present power plant, at a cost of $150,000; the equipment will include four engines, one steam and three gas, and four generators, with a rating of 3750 kw each. Orders have been placed for the generators, which will be built by the Crocker-Wheeler Co., of Ampere, N. J.

GRAND RAPIDS, MICH.—The Board of Public Works is contemplating asking the City Council for an appropriation of $10,000 for extensions and improvements to the municipal electric-light plant.

HILLSDALE, MICH.—The Council is considering the installation of a cluster-lamp system for lighting the streets.

IRONTON, MICH.—The Village Council is considering the question of establishing a municipal electric-light plant in Ironton.

PETOSKEY, MICH.—The Council has authorized a special commission to secure bids for the installation of an electrically driven pump for the water-works system.

WAYNE, MICH.—Bids will be received by the water-works committee until Jan. 28 for motors and electrical equipment to be used in connection with a new water-works system. Bids are also asked on installing the motors and electrical equipment and the necessary wiring, etc., inside of the pump house. P. J. Snyder is clerk of the committee.

CLEVELAND, OHIO.—The Otis Steel Co., 3441 Jennings Road, Cleveland, has secured a permit to construct a power house in connection with a group of buildings. New equipment, it is understood, will soon be purchased.

CLEVELAND, OHIO.—The Vedder El. Co., of Cleveland, has been awarded the contract for wiring and installing electrical apparatus in a new four-story addition to the Taylor Arcade. The company has also secured the contract for wiring and installing electrical apparatus in three new shop buildings for the Cleveland Ry. Co., now under construction.

BLOOMFIELD, KY.—Harry M. Logan, proprietor of the Bloomfield light and power system, expects to purchase some wiring supplies.

CARROLLTON, KY.—Within the next four months the managers of the municipal electric-light plant expect to purchase a new boiler, a new alternating-current generator, to take the place of the present direct-current machine, new switchboard, 500 30-ft. (6-in.-top) poles and other line material. R. L. Bartlett is superintendent.

CYNTHIANA, KY.—The Cynthiana El. Lt. Co. expects to purchase some flatirons and fans (133 cycles, 110 volts). C. C. Addams is superintendent.

DAWSON SPRINGS, KY.—The Dawson Lt. & Pwr. Co., of Dawson Springs, has been organized to take over the electric department of the Dawson Milling Co. The present plant has an output of 60 kw, direct current, and it is proposed to change the system to alternating current with an output of 100 kw in about 12 months. The cost of changing the plant is estimated at from $12,000 to $15,000. The company at present has 60 meters and is preparing to install 75 more. It also has a contract for street-lighting pending. No new equipment will be purchased at present. K. Kevil, of Sikeston, Mo., is engineer in charge.

MOUNT OLIVET, KY.—The installation of a municipal electric-light plant in Mount Olivet, to cost $5,000, is reported to be under consideration.

KENDALLVILLE, IND.—The City Council has passed an ordinance appropriating $4,000 for posts, equipment and installation of a boulevard lighting system on Mitchell and Rush Streets.

MULBERRY, IND.—The Mulberry Lt. & Pwr. Co. is contemplating some extensions in the early spring and may purchase some transformers. Nothing definite yet decided upon. Albert I. Yundt is treasurer.

ROYAL CENTER, IND.—The Royal El. Lt. Co., Ltd., of Royal Center, expects to purchase a few arc lamps and incandescent lamps. W. H. Bingham is secretary.

BATH, ILL.—Within the next few months the managers of the municipal electric-light plant expect to purchase a 100-amp generator. L. F. Roloff is manager.

CHICAGO, ILL.—Bids will be received by John McGillen, clerk of the Sanitary District of Chicago, room 600, 900 South Michigan Avenue, Chicago, Ill., until Jan. 15, for series, alternating-current, inclosed flame-arc lamps. Specifications may be obtained upon application to the above office. For details see proposal columns. Thomas A. Smyth is president of board of trustees.

CHICAGO, ILL.—Bids will be received by the clerk of the Sanitary District of Chicago, Room 700, 900 South Michigan Avenue, Chicago, Ill., until Jan. 29 for construction of the superstructure of a trunnion bascule bridge across the south branch of Chicago River at Jackson Street, in the city of Chicago, as follows: (a) Bridge superstructure; (b) operating houses, machinery, inclosures, etc. (alternative one), or (b) operating houses, machinery inclosures, etc. (alternative two); (c) lamp standards; (4) 20,000 lb. of reinforcing metal furnished and placed ;(e) 25 cu. yd. of extra concrete; (f) 10,000 ft., board measure, of extra untreated timber and lumber; (g) extra creosoted timber and lumber; (h) extra structural steel; (i) extra machinery steel; (j) extra steel castings; (k) extra machinery iron castings; (l) extra iron castings; (m) extra bronze and babbitt. All proposals must be made upon blank forms of proposal furnished by the Sanitary District. Specifications, contract, form of proposal and plans may be obtained upon application at the office of the Sanitary District. A deposit of $15 will be required for each set of plans taken out, which will be refunded upon return of same. Thomas A. Smyth is president of board of trustees.

GENEVA, ILL.—Within the next six months the managers of the municipal electric-light plant and water-works system expect to erect a new boiler house and install two boilers; also to purchase two 300-hp boilers, air compressors and feed-water heaters. Olof Peterson is superintendent.

JOLIET, ILL.—The City Council has decided to contract with the Pub. Ser. Co. of Northern Illinois, of Chicago, for electricity to operate the city pumping station for a period of five years.

MELVIN, ILL.—The Central Illinois Pub. Ser. Co., of Mattoon, has been granted a franchise to operate an electric-light system in Melvin. The company will probably be given a contract for lighting the streets of the village.

MONMOUTH, ILL.—The Monmouth Pub. Ser. Co. has increased its capital stock from $600,000 to $1,000,000. The stockholders of the company have ratified plans for improvements to the plant, to cost about $100,000.

MOUNT CARMEL, ILL.—The Mount Carmel Public Utility & Service Co., which recently purchased the light, heat and water plants at a public sale, will make improvements to the properties. Phillip Barnhard, of Mount Carmel, is secretary and treasurer.

MOUNT VERNON, ILL.—The Citizens' Gas & El. Co., of Mount Vernon, is contemplating making extensions to its plant and system. The company was recently granted a 35-year franchise by the City Council.

NEPONSET, ILL.—The Village Board has granted the Kewanee Lt. & Pwr. Co., of Kewanee, a 20-year franchise to supply electricity for lamps and motors in Neponset. The service will be furnished by the transmission line of the company extending from Kewanee to Sheffield.

ROCK FALLS, ILL.—Bonds to the amount of $8,000 have been voted for improvements to the municipal electric-light plant.

SHAWNEETOWN, ILL.—The managers of the municipal electric-light plant expect to replace the street arc lamps with tungsten lamps within the next six months. George E. Porter is superintendent.

STEWARD, ILL.—Within the next six months the Steward El. Lt. & Wtr. Co expects to erect one storage tank of 8000-gal. capacity for fuel oil. C. T. Beitel is proprietor.

STONINGTON, ILL.—The village of Stonington expects to purchase within the next five months a generating unit for the municipal electric-light plant; also within the next three months some washing machines. O. W. Culbertson is manager and purchasing agent.

WEST FRANKFORT, ILL.—Steps have been taken toward the organization of a utility company in West Frankfort to be capitalized at $250,000. The promoters have in view three franchises covering street railway, water and gas privileges. The survey for the proposed electric railway runs from the new Orient mine, west of West Frankfort, to Old Frankfort, 1 mile east, and includes a spur to each of the large coal mines there. C. E. McClintock, of Johnston City, Ill., and others are interested.

WINCHESTER, ILL.—The City Council has granted a 25-year franchise to a company recently formed to operate an electric-light plant. Under the terms of the franchise work must begin on the plant within three months. R. W. Frost, E. J. Frost, E. D. Smith, C. W. Banes, R. M. Riggs and others are interested in the project.

DOUSMAN, WIS.—The local electric-light plant, owned by R. L. Adams, has been purchased by L. J. Bischel, who will remove it to his mill. Work will begin at once on the erection of the transmission line from the mill to the village.

KENOSHA, WIS.—Work will begin at once on rebuilding the lines of the Kenosha Home Tel. Co. The cost of the work is estimated at from $60,000 to $80,000.

CLARA CITY, MINN.—The Village Council is negotiating with Maynard Council and the Montevideo El. Lt. & Pwr. Co., of Montevideo, with a view of securing electrical service for the town. Bonds to the amount of $5,000 were recently voted to install an electric-light system. If the service is secured from the Maynard plant, the village will erect the transmission line from the plant to Clara City.

DE GRAFF, MINN.—The proposal to issue bonds for the installation of a municipal electric-light plant in De Graff will soon be submitted to the voters.

INTERNATIONAL FALLS, MINN.—The Minnesota & Ontario Pwr. Co. is planning to install an additional generating unit and auxiliary equipment at its plant in International Falls to generate electricity for the paper mills and other industrial plants here.

MINNEAPOLIS, MINN.—The contract for furnishing electricity for 2800 lamps for lighting the streets of the city has been awarded to the Minneapolis General El. Co. at $60 per lamp per year. The company was also awarded the contract for supplying energy for the Corinthian standard lamps at $45 per standard per year.

WINONA, MINN.—Bids will be received by the State Board of Control, St. Paul, Minn., until Jan. 15, for the construction of model school building at the State Normal School, Winona, Minn., including general contract work, heating and ventilating, plumbing and electrical work, in accordance with plans and specifications prepared by C. H. Johnston, architect, Capital Bank Building, St. Paul. Bids will be received collectively or separately. Copies of plans may be seen at the Builders' Exchange in St. Paul and Minneapolis, at the office of the president of the State Normal School, Winona, and at the office of the State Board of Control, St. Paul.

FARNHAMVILLE, IA.—Bids will be received by the Town Council until Jan. 19 for furnishing material and constructing an electric light and power system in Farnhamville. Work must begin on the plant on or before March 1 and be completed by June 1, 1914. Plans are on file in the office of J. W. Hartinger, clerk.

FONTANELLE, IA.—The Electric Light Commissioners expect to purchase within the next two months one carload of 25-ft. and 30-ft. poles, heating and cooking apparatus, etc. The town has just installed an electric-light and water plant. Electricity for operating the system is purchased from the municipal electric plant in Greenfield and is transmitted over a 6600-volt line, 7 miles long, erected by the town of Fontanelle. L. F. Troxel is manager.

LEON, IA.—Within the next six months the Leon El. Co. expects to erect 6 miles of 2300-volt, single-phase transmission line; also to purchase one 150-hp tubular boiler, a 150-lamp series street-lighting system, one carload of poles and 12 electroliers. J. F. Smith is president.

MANNING, IA.—Within the next three months the Manning El. Lt. Co. expects to purchase one triplex pump (7 in. by 8 in.)

and sand points and pipes; also 25 steel electroliers for five-lamp clusters. H. Ohrt is president.

MOULTON, IA.—J. G. Bolton, owner of the local electric-light plant, expects to purchase during the summer of 1914 a coal-handling system; may also purchase some electrical appliances and supplies, etc. A day service is now furnished by the plant.

NEWTON, IA.—The Electric Light Commission expects to purchase within the next three months one 150-hp boiler for the municipal electric-light plant. C. O'Leary is superintendent.

ROCK VALLEY, IA.—The Rock Valley El. Co. expects to erect a new power house or about 11 miles of transmission lines within the next six months; also to purchase one 100-hp Corliss engine, one 25-hp engine, one 75-kw generator and switchboard and two 80-hp boilers; also to purchase within the next 12 months about $500 worth of wiring supplies and 40 hp in motors. S. Thayer is manager.

SUMNER, IA.—Within the next six months the Sumner Lt. & Pwr. Co. expects to erect 12 miles of transmission lines; also to purchase one 50-kva transformer and a supply of electrical appliances and supplies, including heating and cooking apparatus, vacuum cleaners, washing machines, wiring supplies, etc.; also within the next three months to purchase five car loads of 25-ft. (6-in.-top) poles. Charles Kurmence is manager.

VOLGA, IA.—Oscar Weisner has been granted a franchise to construct and operate an electric-light and power plant for a period of 25 years.

JOPLIN, MO.—The Empire District El. Co., of Joplin, is installing a 2500-kva low-pressure exhaust turbine to be operated in conjunction with the reciprocating engine plant at Riverton, Kan.

PIEDMONT, MO.—The Piedmont El. Lt. & Pwr. Co. is planning to install an electric-light plant to be operated by oil engines. The present plans provide for a 20-kw, 2300-volt plant, with 3 miles of transmission lines. W. E. Bunyard, of Bonne Terre, Mo., is manager.

CASSELTON, N. D.—Hallett & Lynch have been granted a franchise to install an electric-light plant in Casselton; also a contract for street lighting.

DICKEY, N. D.—A proposal has been submitted to the Town Council by J. L. Tucker, representing a St. Paul electric company, offering to install an electric-light plant in Dickey.

McCLUSKY, N. D.—Phillip Kiefer, of Moorhead, Minn., has submitted a proposal to the Council offering to install an electric-light plant in McClusky, provided he is given a franchise and a site for plant.

WYNDMERE, N. D.—The installation of an electric-light plant in Wyndmere is under consideration. One or two propositions for the establishment of a private plant have been submitted, but general sentiment is favorable to municipal ownership.

DELL RAPIDS, S. D.—A franchise has been granted to N. C. Draper to install an electric light and power system in Dell Rapids.

GREAT BEND, KAN.—Within the next three months the Great Bend Wtr. & El. Co. expect to purchase coal and ash handling systems and some electric heating ranges. The company has recently purchased a carload of poles to improve its distributing system. J. R. Murphy is manager.

HAVEN, KAN.—The Haven El. & Ice Co. expects to purchase within the next two months one 35-hp or 45-hp center-crank, high-speed steam engine (second-hand preferred).

LE ROY, KAN.—At an election held recently bonds to the amount of $13,000 were voted for the installation of a municipal electric-light plant.

LIBERAL, KAN.—Within the next four months the Liberal Lt., Ice & Pwr. Co. expects to purchase 500 lb. No. 6 weather-proof wire and a carload of 25-ft. and 30-ft. (6-in.-top) treated cedar poles. H. W. Magruder is president and manager.

LINDSBORG, KAN.—The town of Lindsborg expects to purchase within the next 12 months one or two 200-hp boilers and street lamps. M. H. Blaine is superintendent.

RUSSELL, KAN.—The city of Russell expects to install within the next three months an auxiliary generating unit in the municipal electric-light plant, consisting of a 60-hp to 100-hp engine, a 50-kw to 75-kw generator, and switchboard. M. C. Fox is city manager.

SPEARVILLE, KAN.—The Diamond El. Lt. & Pwr. Co., of Spearville, expects to purchase 25 meters within the next 12 months. Thomas J. Stinson is manager.

Southern States

DANBURY, N. C.—We are informed that the installation of an electric-light plant in Danbury is not contemplated, as reported in the issue of Dec. 13. M. T. Chilton is clerk.

WILMINGTON, N. C.—We are informed that the city of Wilmington has taken no definite action in regard to establishing a municipal electric-lighting plant. F. F. Pillet is city engineer.

COLUMBUS, GA.—The Southern Ferro Concrete Co., engineers and contractors, Georgia Building, Atlanta, Ga., has been awarded the general contract for the construction of the Columbus Hotel, Columbus, Ga., including the reinforced-concrete skeleton frame, elevators, plumbing, heating, electrical work, fixtures, refrigeration plant, kitchen equipment, etc. The building will be ten stories high and will cost about $200,000. Parties interested in furnishing bids should address the company at its Atlanta office.

GLENVILLE, GA.—The Council has engaged the J. B. McCrary Co., of Atlanta, Ga., as engineers and contractors for the proposed municipal electric-light plant. Dr. L. A. DeLoach is Mayor

VALDOSTA, GA.—Plans are being considered for the construction of a power plant on the Willacoochee River, about 3 miles from Valdosta, for which preliminary surveys are now being made by A. B. Langford, of Valdosta, civil engineer.

ZEPHYRHILLS, FLA.—The Zephyrhills El. Lt. & Pwr. Co. has changed its name to the Zephyrhills El. Co. The company expects to purchase some wire and a few motors. Waldo M. Francisco is president.

JACKSON, TENN.—At an election to be held Jan. 19 the proposal to issue $25,000 in bonds, the proceeds to be used for enlarging power plant and extensions to lighting system, will be submitted to the voters.

BIRMINGHAM, ALA.—The Tidewater Co. will soon submit to the city commission a request for a franchise for the entire system which it proposes to build in Birmingham. The present plans provide for a street-railway system making connections with the present main line to all of the principal suburbs of Birmingham, including Norwood, Avondale, the Southside, West End, Powderly and Bessemer. George Brown is vice-president and chief engineer.

CLAYTON, ALA.—Bonds to the amount of $5,000, it is reported, have been voted for improvements to the municipal electric-light system.

OPELIKA, ALA.—The managers of the municipal electric light and power plant have recently purchased a 150-kw generator and a 225-hp engine. Charles Schafer is superintendent.

VICKSBURG, MISS.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 30 for the installation of an electric passenger elevator in the extension of the United States post office and court house in Vicksburg, Miss. For details see proposal columns. O. Wenderoth is supervising architect.

MURFREESBORO, ARK.—The Murfreesboro Lt. & Pwr. Co. is planning to install an electric light and power plant. The equipment will consist of one 125-hp tubular boiler, one 100-hp engine, one 75-kw alternating-current, 60-cycle, 2300-volt generator, one marble switchboard, oil switches, ammeters, voltmeter and possibly five transformers, 150 poles and 8 miles of wire (approximately), single-phase recording meters and tungsten street-lighting system. No contracts for equipment will be let at present. W. E. Rafferty, of Murfreesboro, is engineer in charge of the work.

OZARK, ARK.—George F. Brockman, owner of the local electric-light plant, has recently installed a 75-kw, single-phase, 60-cycle Fort Wayne generator, a Hoppe open heater and new switchboard, and has also rebuilt the distributing systems in Ozark, Altus and Deming.

RUSSELLVILLE, ARK.—A group of St. Louis financiers has organized a company to furnish electricity for lamps and motors in seven Arkansas towns in Yell and Conway Counties between Fort Smith and Little Rock. The company, which will be known as the Seven Cities Co., has taken over the Russellville hydroelectric plant and expects to close options on plants in neighboring towns soon. It is proposed to consolidate the light and power plants in most of these towns into one central plant, with branches. The towns are within a radius of 40 miles of Russellville. The chief towns to be served are Russellville, Dardanelle, Morrilltown, Dover and Cabin Creek. The plant at Russellville is located at the Junction of the Illinois and Arkansas Rivers. The company is capitalized at $500,000. R. D. Smith is president of the new company.

DE RIDDER, LA.—The De Ridder Lt. & Pwr. Co., it is reported, is contemplating the construction of a power plant, to cost about $30,000.

SUPPLY, OKLA.—Bids will be received by the Board of Trustees of Supply until Jan. 13 for the construction of an electric-light plant and water-works system, to cost $18,500.

ARANSAS PASS, TEX.—Work will probably begin some time in January or February on the proposed municipal electric-light plant in Aransas Pass, for which $8,000 in bonds were recently voted. Bonds to the amount of $22,000 were also voted for a water-works system. As yet an engineer has not been engaged. Charles H. Gile is city clerk.

NAVASOTA, TEX.—The Navasota Lt. & Pwr. Co. has increased its capital stock from $20,000 to $200,000 and has changed its name to the Navasota Ice, Lt., Pwr. & Wtr. Co. Extensive improvements and additions will be made to its light and power plants and water-works system.

Pacific States

BREMERTON, WASH.—The City Council has rejected the proposal submitted by Gustav F. Rust, of Colby, representing a group of promoters, offering to build an electric plant on the Hama Hama River, near Eden Ferry, and to transmit energy to Bremerton; construct a street and interurban railway system, and turn the entire system over to the city at the end of three years for $350,000. The Council has decided to call a special election to vote on the question of establishing a municipal electric-light plant.

CONCONULLY, WASH.—The Big Bend Lt. & Pwr. Co., controlled by the Okanogan Valley Pwr. & Lt. Co., of Spokane, has applied to the County Commissioners of Okanogan County for a franchise to extend its transmission lines over all roads in Okanogan County. The company proposes to extend its transmission lines from Brewster to Omak and Okanogan.

OKANOGAN, WASH.—In order to increase the water supply for the Okanogan irrigation project in the State of Washington, the Secretary of the Interior has approved the recommendation of the Board of Reclamation Commissioners that plans be made immediately for the development of power to pump water for about 1050 acres. Power will be developed at two drops in the main canal. The sum of $82,000 has been allotted from the reclamation fund for the work.

OMAK, WASH.—The City Council has granted the Okanogan Lt. & Pwr. Co., of Okanogan, a franchise to furnish electricity for lamps and motors here. Arrangements are being made to erect a transmission line to Omak.

PUYALLUP, WASH.—The Puget Sound Trac., Lt. & Pwr. Co., of Seattle was recently granted the contract for furnishing electricity for lighting the city for a period of four years. A large number of arc lamps will be erected in the business district and tungsten lamps in the residential district. About $5,000 will be expended for improvements to the local system.

SEATTLE, WASH.—The City Council has authorized the Light Department to expend $20,000 for making necessary alterations in the municipal substation at Seventh Avenue and Yesler Way.

SPOKANE, WASH.—The Trustee Company has applied for a franchise to install underground conduits for furnishing electricity for heating and lighting service throughout the city. The company proposes to install a plant to cost eventually from $300,000 to $400,000. Harry A. Flood is president of the company.

EUGENE, ORE.—The Booth Kelly Lumber Co., of Eugene, has engaged the West Coast Engineering Co., of Portland, to prepare plans and take charge of the installation of an electric-lighting and power system in the large sawmill being erected by the lumber company in Springville, Ore. Motors ranging from 200 hp to 300 hp (aggregating 2500 hp) will be installed. Three-unit monorail systems will be installed in the yards for handling lumber.

KLAMATH FALLS, ORE.—The Department of the Interior, Washington, D. C., has acted favorably on the petition of the city of Klamath Falls for the establishment of a power plant in connection with the Klamath reclamation project. The government is to construct the plant and the city to finance the same.

NEWBERG, ORE.—The Yamhill El. Co. expects to install a 500-kva step-down

transformer to furnish electricity in Newberg. The company has entered into a contract with the Portland Ry., Lt. & Pwr. Co., of Portland, for energy to operate its system. C. J. Edwards is manager.

BURNEY FALLS, CAL.—The Board of Supervisors of Shasta County has granted the Pitt River Pwr. Co. a franchise to furnish electricity in Fall River and Burney Valleys. The company proposes to build a power plant in Burney Falls to have an output of 1000 hp at a cost of about $50,000

CALISTOGA, CAL.—The Calistoga El. Co. is contemplating the purchase of poles, wires, meters and voltmeter (recording). C. W. Couch is secretary and manager.

DURHAM, CAL.—Within the next 12 months the Durham Lt. & Pwr. Co. expects to purchase a few transformers, insulators, meters, etc., and to expend about $200 for incandescent lamps. J. A. Foster is manager.

LAKEPORT, CAL.—The Mount Konocti Lt. & Pwr. Co., of Lakeport, expects to purchase within the next 12 months 1500 incandescent lamps. A. N. Joslin is general manager.

REDLANDS, CAL.—The Holton Pwr. Co., of Redlands, expects to erect within the next six months a substation at El Centro and to connect the high-tension transmission line to be erected by the Coachella Valley Ice & El. Co. from Banning to El Centro with the present lines of the Holton company in the Imperial Valley. W. G. Driver is secretary.

RIVERSIDE, CAL.—The Southern Sierras Pwr. Co., of Riverside, will take over the lines of the Temescal Wtr. Co. and furnish power for operating the pumping plants of the water company in Temescal Canyon. The plant of the Temescal company at Ethanac was closed down Jan. 1, 1914.

SAN FERNANDO, CAL.—The Pacific Lt. & Pwr. Corpn., of Los Angeles, is contemplating rebuilding its distribution system throughout the town of San Fernando.

SAN FRANCISCO, CAL.—The Board of Public Works has authorized the city engineer to prepare plans for a street-lighting system for streets traversed by extensions of the municipal railway and to prepare specifications for the enlargement of the Geary Street carhouse.

SUTTER CREEK, CAL.—The South Eureka Co., is planning to equip its Oneida Mine with electrically operated machinery.

GENESEE, IDAHO.—The Washington Wtr. Pwr. Co., of Moscow, has submitted a new proposal to the City Council for furnishing electricity for lamps and motors in Genesee. Two street-lighting contracts have been offered, one for five years and the other for ten years. The Council is also considering tungsten lamps for street-lighting.

IDAHO FALLS, IDAHO.—The City Council has granted the Idaho Falls El. Co. a franchise to build a power house in Idaho Falls. Under the terms of the franchise the company cannot sell electricity for commercial purposes in Idaho Falls.

PRIEST RIVER, IDAHO.—The Council is considering the question of establishing a municipal electric-light plant in Priest River.

PRIEST RIVER, IDAHO.—Investigations are being made by L. V. Smith and a party of engineers of the power sites on the Priest River, owned by the Pan Handle Ry. Co., with a view of building a power plant to supply electricity to nearby towns as soon as the situation warrants.

ST. ANTHONY, IDAHO.—The Utah Pwr. & Lt. Co., it is reported, is contemplating the construction of a new power house on the site of the present station in the spring. The new plant will have an output of 750 hp.

CLIFTON, ARIZ.—The Arizona Copper Co., Ltd., of Clifton, expects to install 600 kva in transformers in the Clifton substation to furnish electricity to operate the Clifton pumping station. Norman Carmichael is vice-president and general manager.

CROWN KING, ARIZ.—The Nelson Mining Company is planning to build an electric railway from Crown King to its holdings, about 1 mile distant. An electric power plant, it is stated, will be built in Crown King.

BILLINGS, MONT.—Surveys, it is reported, have been completed by the Big Horn Canyon Irrigation & Pwr. Co. for a railroad from Canyon to Custer, a distance of 68 miles. Power for operating the proposed railroad will be developed from a dam in the Big Horn Canyon.

GLASGOW, MONT.—The city of Glasgow will soon award a contract for the installation of a new street-lighting system, including 400 lamp standards and 100 blocks of cement walk. The latter part of January the city will also place an order for an additional electric generating unit for the municipal electric-light plant. E. S. Severance is city engineer.

HELENA, MONT.—An election will be called by the City Council the latter part of January or the first of February to submit the proposal of granting a franchise to the Standard Engineering Co., of Seattle, Wash. Preliminary plans provide for a steam plant at first; later a larger plant will be built.

Canada

LACOMBE, ALTA.—The town of Lacombe is planning to install, in the near future, an engine-driven, 100-kw, three-phase, 60-cycle, 2300-volt generator, complete with field rheostat and pulley from which to belt an exciter. E. J. Tett is manager.

BRANDON, MAN.—A proposition has been submitted to the City Council by C. Chamberlain relative to transmitting electricity from Silver Falls to Brandon.

WINNIPEG, MAN.—Tenders will be received by the Board of Control for furnishing and erecting in the power house at Point du Bois one head-gate-lifting mechanism, including the necessary accessories.

WINNIPEG, MAN.—Tenders will be received until Jan. 29 for furnishing electrically operated switching apparatus and accessories for the King Street substation. Plans and specifications may be obtained at the office of the Light and Power Department, 54 King Street, Winnipeg. M. Peterson is secretary of Board of Control.

WOODSTOCK, N. B.—The Maine & New Brunswick El. Pwr. Co., of Presque Isle, Maine, has applied for a franchise to erect transmission lines in Woodstock to furnish electricity for lamps and motors.

HANTSPORT, N. S.—Several proposals have been submitted to the Town Council recently for lighting the town by electricity.

FORT WILLIAM, ONT.—The Kaministiquia Pwr. Co., of Fort William, proposes to increase its capital stock from $2,000,000 to $2,500,000 and will issue about $200,000 to pay for the cost of an additional installation of 12,000 hp.

ORILLIA, ONT. — The Hydro-Electric Power Commission of Ontario has been asked to submit a proposal to furnish the town of Orillia with a 24-hour service from the Big Chute plant. This would do away with the proposed installation of a new plant by the town of Orillia.

WELLAND, ONT.—Tenders will be received by William H. Lowe, secretary of the High School board of Welland, until Jan. 17, for construction of new high school building complete, including electric wiring. Separate tenders for each part of the work or bids for the entire work will be considered. Plans and specifications may be obtained upon application to D. F. Forbes, architect, 43 Temple Building, Welland.

COTE ST. PAUL, QUE.—In order to secure more power the Department of Railways and Canals of the Canadian government is constructing a new power house at Côte St. Paul, on the Lachine Canal, Quebec. At present there are two power houses on the canal. One will now be abandoned and a new one built near the site of the second. The building will be 70 ft. by 70 ft. New generating equipment will be installed, consisting of four turbine wheels 60 in. in diameter and one turbine wheel 30 in. in diameter, two exciter wheels, five generators and two transformers. Provision is made for an output of a total of 650 hp. Electricity generated at the plant is utilized for lighting the waterway and for opening and closing dock gates.

MONTMORENCY FALLS, QUE. — The Dominion Textile Co. is making extensions to its plant in Montmorency Falls. New machinery installed will be driven by electricity.

QUEBEC, QUE.—The Merchants' Lt., Ht. & Pwr. Co. has submitted to the local Legislature a by-law asking permission to amend its charter by increasing its capital stock from $800,000 to $3,000,000.

WILKIE, SASK.—The Town Council is considering the question of submitting a by-law to ratepayers providing for an appropriation of $30,000 for extensions and improvements to the electric-light system in Wilkie. It is proposed to install an additional engine to increase the output of the plant to meet the increasing demands of electricity for lighting and later to supply power for industrial plants.

Miscellaneous

VALDEZ, ALASKA.—The Valdez El. Pwr. Co., recently organized, is planning to erect a power plant, transmission lines, etc., during the coming year. The officers of the company are: E. E. Ritchie, president; George J. Love, secretary, and W. H. Blackwell, treasurer.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Jan. 21, for signal cable and cable end bells, filling compound for same, and vitrified salt-glazed conduit. Blanks and general information relating to this circular (No. 818) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major Boggs is general purchasing officer.

New Incorporations

AURORA, ILL.—The Dayton & Ottawa Pwr. & Lt. Co. has been chartered with a capital stock of $100,000 to develop and distribute water, electrical and other power. The incorporators are De Witt E. Northam, Sidney E. Blanc and F. W. Simpson.

GLYDON, MINN.—The Glydon Lt. & Pwr. Co. has been incorporated by A. J. Fitzsimmons and others.

KINGS, N. C.—The Dan River Ry. Co. has been incorporated by Harlee Miller, of Clements; B. E. Kapp, of Bethania, and E. C. Butler, of Hamilton, N. Y. The company proposes to construct and operate interurban electric railways between towns in Stokes and adjacent counties; also to develop electrical power for lamps, motors and other purposes.

HARRISBURG, PA.—Charters were issued by the State Department on Dec. 31 for 11 new companies to operate in the eastern part of Bucks County, covering the towns and townships of Bristol, Bensalem, Bridgetown, Durham, Falls, Lower Makefield, Upper Makefield, Nockamixon, Plumstead, Solebury and Tinicum. The incorporators are S. D. Warriner, of Philadelphia; Rollin H. Wilbur, of St. David's, and B. F. Baker, of Germantown, all interested in the Lehigh Coal & Navigation Co., of Philadelphia. The electric plant of the Lehigh company is in the coal regions, about 50 miles distant from the towns it proposes to furnish with electrical service.

EDGEMONT, S. D.—The Edgemont El. Lt. Co. has been incorporated with a capital stock of $25,000 by Thomas Colgan, Albert Herman and G. W. Highley.

BIG STONE, TEX.—The Big Stone Lt. & Pwr. Co. has been granted a charter with a capital stock of $25,000. The incorporators are I. D. Aldrich, A. C. Lutz, George K. Clark and others.

BOWIE, TEX.—The Bowie Lt. & Pwr. Co. has been incorporated with a capital stock of $50,000 by Hiram Grossman, Mose Grossman and W. C. Woodlief. The office of the company will be in Dallas.

BURKBURNETT, TEX.—The Burkburnett Lt. Co. has been incorporated with a capital stock of $5,400 by G. W. Wigham, B. Schwegler and August Lehoefener.

PITTSFORD, VT.—The Pittsford Pwr. Co. has been granted a charter with a capital stock of $500,000 to supply electricity for lamps and motors in Pittsford and Chitterden, Vt. The company proposes to issue $400,000 in capital stock at once, the proceeds to be used to purchase two sites for power houses in Chitterden and Pittsford and also to petition for the right to use the water of the Chitterden reservoir. The incorporators are F. E. Smith, C. C. Davis and H. Nash, Jr., all Massachusetts men.

GLIDDEN, WIS.—The Glidden Lt., Pwr. & Wtr. Co. has been incorporated with a capital stock of $5,000 by Fred Boheim, Conrad Mohr, Frank Deringer, Leopold Gibit and Julius Schroeder.

VANCOUVER, B. C.—The Metropolitan El. Co. has been incorporated with a capital stock of $10,000 to do a general electric-light business. The head office of the company will be in Vancouver.

CAUGHNAWAGA, QUE.—The Caughnawaga Lt., Ht. & Pwr. Co. has been incorporated with a capital stock of $50,000 to generate and distribute electricity.

L'EPIPHANIE, QUE.—The Compagnie Electrique de l'Epiphanie, Ltd., has been incorporated with a capital stock of $49,000 by J. A. Borbeau, J. B. T. Richard and M. Forest.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 30, 1913.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N. Y.]

1,082,511. Alternating-Current Motor; C. Le G. Fortescue, Pittsburgh, Pa. App. filed Feb. 21, 1911. Auxiliary transformer associated with the motor so as to permit relative adjustment between the armature current and field current.

1,082,529. Apparatus for Forming Oxides of Nitrogen; J. S. Island, Toronto, Canada. App. filed Dec. 27, 1911. Supply of oxy-nitrogen gas is passed through an electric arc flame.

1,082,532. Dynamo-Electric Machine; B. G. Lamme, Pittsburgh, Pa. App. filed Feb. 21, 1911. Damper or auxiliary winding for field members of rotary converters and other synchronous machines.

1,082,561. System of Distribution; E. H. Schwarz, New York, N. Y. App. filed Dec. 21, 1910. Polyphase constant alternating-current distribution or lighting system.

1,082,563. Coil for Electrical Apparatus; H. B. Smith, Worcester, Mass. App. filed Jan. 26, 1910. Spiral form of coil for high-voltage transformers, etc.

1,082,571. Commutator Brush; T. W. Varley, New York, N. Y. App. filed Nov. 13, 1908. Strap brushes make sidewise tangential engagement with the commutator cylinder.

1,082,579. Dynamo-Electrical Machine; D. H. Andrews and E. C. Ketchum, Boston, Mass. App. filed Jan. 31, 1912. Prevents displacement of any of the elements of the armature when same is driven direct from high-speed turbine.

1,082,587. Metal-Filament Incandescent Lamp; M. D. Greengard, New York, N. Y. App. filed Jan. 30, 1913. Filament supported on hooked ends of arms carried by two spaced cross-rods.

1,082,596. Treating Metal-Carrying Ores; I. Kitsee, Philadelphia, Pa. App. filed Aug. 14, 1908. Accelerates action of cyanide solution on metal-carrying ore by applying currents of electricity to said liquor for comparatively short periods.

1,082,603. Alternating-Current Induction Motor; B. McCollum, Washington, D. C. App. filed March 18, 1912. Nickel resistances in the secondary circuit of an induction motor.

1,082,606. Supervisory Alarm System; J. G. Nolen, New York, N. Y. App. filed Aug. 1, 1912. Electro-pneumatic system.

1,082,615. Electric Switching Device; R. Wikander, Pittsburgh, Pa. App. filed March 23, 1911. Electromagnetic switch for use in unit switch-control systems for motors.

1,082,653. Induction Wattmeter; G. A. Scheeffer, Indianapolis, Ind. App. filed Aug. 31, 1910. Overcomes "singing" by providing a "magnetic cushion" for the upper bearing of the armature shaft.

1,082,654. Electric Meter; G. A. Scheeffer, Indianapolis, Ind. App. filed Jan. 14, 1910. Lifting device for raising the armature from its lower bearing.

1,082,667. Automatic Resetting Alarm Cut-Out for Electric Burglar-Alarm Systems; J. P. Williams and H. Huhn, New York, N. Y. App. filed Dec. 16, 1910. An electric protective circuit is automatically controlled to sound and cut out an alarm and the cut-out is automatically reset after its period of operation.

1,082,683. Automatic Cut-Out and Compensating Socket; G. T. Dunklin, South Bend, Ind. App. filed March 21, 1912. For series lighting circuits.

1,082,694. Electric Switch; E. A. Halbleib, Rochester, N. Y. App. filed Nov. 29, 1912. Switch plugs longitudinally movable through the walls of a casing inclosing contact devices.

1,082,703. Supervisory Alarm System; J. G. Nolen, New York, N. Y. App. filed Aug. 1, 1912. Protective piping connected to fluid-pressure-actuated alarms initiating devices.

1,082,721. Liquid Resistance; A. Aichele, Baden, Switzerland. App. filed Aug. 8, 1913. Electrolyte is movable in respect to the electrodes.

1,082,731. Combination Lock and Circuit-Breaker; G. J. Buckeye, Kansas City, Mo. App. filed Aug. 21, 1911. To prevent unauthorized use of automobile.

1,082,759. Panelboard Switch; J. A. Obermiller and P. Eickenberg, Chicago, Ill. App. filed July 29, 1912. Panelboard switch which may be quickly applied to the branch bars of a panelboard.

1,082,767. Riveted Metal-Work; A. F. Rietzel, Charlestown, R. I. App. filed Sept. 16, 1909. Employs a rivet and uses electric heat and pressure to weld parts together.

1,082,772. Conductor Post for Electrical Distribution; C. Schuster and C. N. Bergmann, Pittsburgh, Pa. App. filed March 3, 1911. For knife switches; large ampere capacity and ample contact area.

1,082,810. Electric Device; A. A. Kent, Philadelphia, Pa. App. filed June 12, 1908. Contact device for internal combustion engines.

1,082,811. Device for Uniting Insulated Conductors of Electricity; A. A. Kent, Philadelphia, Pa. App. filed Jan. 24, 1911. High-potential connecting device.

1,082,825. Automatic Train Stop; H. G. Sedgwick, Mill Valley, Cal. App. filed Dec. 24, 1908. When engineer cuts out brake mechanism operating circuit controlled by the roadbed devices is broken.

1,082,840. Automatic System of Block Signaling for Electric Railways; S. M. Young, New York, N. Y. App. filed May 4, 1908. Alternating-current system with rails conductively continuous and impedances connected at intervals across rails.

1,082,856. Attachment for Controlling Telephone Switch Hooks; J. Frith, Bridgeport, Conn. App. filed Nov. 8, 1912. Receiver-supporting arm with a manually operable catch for controlling the usual receiver hook.

1,082,869. Storage Battery; A. S. Hubbard, Greenwich, Conn. App. filed Aug. 3, 1912. Vent duct for sealed batteries.

1,082,887. Contact Device for Hand-Lamps; L. Maisel, Madison, Wis. App. filed Sept. 13, 1913. Thumb-piece must first be thrust inward before it can be slid into circuit-closing position.

1,082,920. Damper-Regulating Apparatus; H. B. Weir and J. L. Fyke, Milwaukee, Wis. App. filed Feb. 14, 1912. Thermostat controls magnet, which by pawl and ratchet operates drum connected by cords with dampers.

1,082,933. Tungsten and Method of Making the Same for Use as Filaments of Incandescent Electric Lamps and Other Purposes; W. D. Coolidge, Schenectady, N. Y. App. filed June 19, 1912. Relates to the manufacture of drawn wire for tungsten lamps.

1,082,950. Arc-Light Electrode; J. L. R. Hayden, Schenectady, N. Y. App. filed July 15, 1909. Metallic compounds fused and poured in fluid mass into a metal shell.

1,082,951. Combined Conductor's Valve and Emergency Switch; F. Hedley and J. S. Doyle, Mount Vernon, N. Y. App. filed July 11, 1912. Operated to apply brakes and cut off current supply to motors.

1,082,956. Automatic Control System for Electric Railways; B. F. Hutches, Jr., Allendale, N. J. App. filed Feb. 7, 1912. For single track; current automatically cut off at the switch until the track has been cleared.

1,082,962. System of Distribution; H. A. Laycock, Schenectady, N. Y. App. filed April 8, 1911. Means for varying the energy, inserted in each side or leg of a three-wire system.

1,082,971. Subterranean Heater; A. Pick, New York, N. Y. App. filed Jan. 2, 1913. For heating oil wells, etc.; embodies plurality of rigidly supported removable and replaceable resistance elements.

1,082,978. Arc-Lamp Electrode; C. P. Steinmetz, Schenectady, N. Y. App. filed Dec. 10, 1903. Composed of carbon associated with titanium carbide.

1,082,982. Rheostat; R. L. Watkins, New York, N. Y. App. filed May 22, 1911. Folding rheostat with plurality of pivoted resistance leaves.

1,083,017. Trolley; P. Johnson, Heaton, N. M. App. filed May 1, 1913. Spring-pressed guard pivoted on spindle of trolley wheel.

1,083,047. Trolley; M. Adamski, Stoneboro, Pa. App. filed April 25, 1913. Pole with triangular-shaped contact head pressed upward by spring piston.

1,083,049. Convertible Trolley; A. L. Bohner and J. Scott, Cleveland, O. App. filed May 31, 1912. Pilot wheel cuts away ice in advance of the trolley wheel and may be replaced by a plain contact wheel.

1,083,066. Method of Treating Molds Used in the Art of Electrotyping; G. E. Dunton, New York, N. Y. App. filed May 22, 1911. Stands the electrotyping mold on edge and melts the same from the pan attached to the back thereof.

1,083,070. Compound Metal; B. E. Eldred, New York, N. Y. App. filed Oct. 26, 1911. Wall of glass with wire of high melting metallic material sealed therethrough and held in the glass under compressive strains.

1,083,076. Typewriting Machine; O. Fischer, Berlin, Germany. App. filed April 26, 1910. Includes a type wheel which is rotated and then thrown against the platen by electromagnetic means.

1,083,085. Loose-Coupled Tuning Coil; A. C. Gowing and M. C. Spencer, Worcester, Mass. App. filed June 21, 1912. Primary and secondary, each made up of two independently adjustable sections.

1,083,109. Magnetic Wedge for Dynamo-Electric Machines; B. F. Lee, Schoolfield, Va. App. filed Dec. 14, 1912. Embodies laminated magnetic wedges in the coil slots.

1,083,132. Electrode for Preventing Cathodic Reduction; A. Pietzsch and G. Adolph, Munich, Germany. App. filed Oct. 3, 1912. Cathode body covered by a winding of asbestos string.

1,083,168. Process of Producing a Resinous Compound; D. Whipple, New York, App. filed Nov. 6, 1909. For insulating cables.

1,083,172. Dry Ore Concentrator; W. E. Winnie and J. E. Seeley, Los Angeles, Cal. App. filed Oct. 30, 1911. Valuable metal separated from finely ground rock by mechanical and electrical means.

1,083,187. Electric-Arc Lamp; F. Buchanan, Dayton, Ohio. App. filed Dec. 9, 1909. Has a pawl-and-ratchet-operated feeding clutch.

1,083,191. Thermoelectric Generator; J. J. Cook, Jersey City, N. J. App. filed March 25, 1911. Thermoelectric pile with markedly low internal resistance.

1,083,210. Arc Lamp; C. A. B. Halvorson, Jr., Lynn, Mass. App. filed Aug. 3, 1909. Has large upper positive electrode and two smaller lower negative electrodes.

1,083,218. Adjustable Combined Shade and Hood Holder; C. G. Rush, Chicago, Ill. App. filed March 28, 1913. Lamp mounted on the face of the fixture or canopy secured to the ceiling or side wall.

1,083,221. Starter for Internal-Combustion Engines; F. R. Simms, Willesden Lane, London, Eng. App. filed Feb. 23, 1910. Combined trimble coil and operating switch.

1,083,222. Electric Ignition Apparatus; F. R. Simms, Willesden Lane, London, Eng. App. filed Dec. 10, 1910. Auxiliary circuit-breaker for use when external current source is used for ignition.

1,083,232. Process for the Production of Ammonia; R. W. Wallace and E. Wassmer, London, Eng. App. filed Aug. 18, 1913. Passes nitrogen over metal capable of forming a nitride which is capable of being subsequently transformed into a sulphide.

1,083,255. Electric Transmission of Intelligence; I. Kitsee, Philadelphia, Pa. App. filed July 13, 1906. Employs a double condenser.

1,083,256. Telephony; I. Kitsee, Philadelphia, Pa. App. filed April 24, 1907. Especially designed for railroad work.

1,083,257. Telegraph System; I. Kitsee, Philadelphia, Pa. App. filed March 28, 1908. Duplex cable system involving an artificial line.

1,083,258. Electric Transmission of Intelligence; I. Kitsee, Philadelphia, Pa. App. filed April 11, 1908. Effects of induction are utilized for transmission of intelligence.

1,083,259. Cable Telegraphy; I. Kitsee, Philadelphia, Pa. App. filed Feb. 14, 1908. Relates to receiving organism of high-capacity lines, such as submarine cables.

1,083,260. Electric Motor; R. E. Noble, Chicago, Ill. App. filed July 2, 1910. Barrel-wound armature with commutator extending wholly within the cord turns of the armature winding.